INTERIM RECORD OF DECISION
ANACONDA COPPER MINE SITE
Arimetco Facilities Operable Unit 8
Heap Leach Pads and Fluids Management System
Lyon County, Nevada

February 2017

U.S. Environmental Protection Agency
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Region 9
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Table of Contents

Table of Contents (continued)

List of Figures

List of Tables

List of Appendices

Acronyms and Abbreviations

amsl	above mean sea level
ARAR	Applicable or Relevant and Appropriate Requirements
ARC	Atlantic Richfield Company
bgs	below ground surface
BHHRA	baseline human health risk assessment
BLM	U.S. Department of the Interior Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CIP	community involvement plan
COC	contaminants of concern
CRP	community relations plan
E-Cell	evaporation cell
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ET	evapotranspiration
EW	electrowinning
FMS	fluid management system
FMS O&M Plan	*Arimetco Heap Leach Fluid Management System Operations and Maintenance Plan, Yerington Mine Site*
FFS	*Yerington Mine Operable Unit 8, Focused Feasibility Study Conceptual Closure Plan*
FS	feasibility study
gpm	gallon per minute
HDPE	high-density polyethylene
HHRA	human health risk assessment
HI	hazard index
HLP	heap leach pad
HQ	hazard quotient
LUC	land-use control
MCL	maximum contaminant level
MOU	memorandum of understanding
NAC	Nevada Administrative Code
NCP	National Contingency Plan
NDEP	Nevada Division of Environmental Protection
NPL	National Priorities List
NPV	net present value
O&M	operation and maintenance
OU	operable unit
PLS	pregnant leach solution
PTW	principle threat waste
Acronyms and Abbreviations	**(continued)**
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act of 1976

RfD	reference dose
RI	remedial investigation
ROD	record of decision
RSL	regional screening level
Site	Anaconda Copper Mine site
SLERA	screening level ecological risk assessment
SLHHRA	*Screening Level Human Health Risk Assessment, Arimetco Heap Leach Pads, Anaconda-Yerington Copper Mine, Yerington, Nevada*
SPS	Singatse Peak Services
SX	solvent extraction
TBC	to be considered
TPH	total petroleum hydrocarbons
USGS	United States Geological Survey
VLT	vat leach tailings
WRPT	Walker River Paiute Tribe

1.0 The Declaration

The declaration functions as an abstract and data certification sheet for the key information in this interim Record of Decision (ROD) and is the formal authorizing signature page for this ROD.

1.1 Site Name and Location

ANACONDA COPPER MINE SITE
EPA #NV083917252
ARIMETCO OPERABLE UNIT (OU-8)
LYON COUNTY, NV

The Anaconda Copper Mine (Site) is of mixed-ownership (private & federal) and is located in the Mason Valley, near the city of Yerington, in Lyon County, central Nevada (Figure 1). The private portions of the Site, once owned and operated by Arimetco, were obtained by Singatse Peak Services through bankruptcy court. The public land portions of the Site are managed by the U.S. Department of the Interior Bureau of Land Management (BLM). Using authority under the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), also known as Superfund, U.S. Environmental Protection Agency (EPA), BLM, and Nevada Division of Environmental Protection (NDEP) are addressing contamination issues at the Site.

1.2 Statement of Basis and Purpose

This ROD presents the selected remedy for the Anaconda Copper Mine, Arimetco Operable Unit (OU), which was chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act and to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record file for the Site.

The three agencies concur with the selected remedy.

1.3 Assessment of Site

The response action selected in this ROD is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants at the Site which may present an imminent and substantial endangerment to public health or welfare or the environment.

1.4 Description of Selected Remedy

The Selected Remedy addresses OU-8, "Arimetco," and is the first OU ROD for the Site. The agencies prioritized the OUs at the Site. It was determined that the highest priority OUs were OU-

8 (Arimetco), OU-1 (Site-Wide Groundwater), OU-3 (Anaconda Process Areas), OU-4a (Evaporation Ponds), and OU-7 (Wabuska Drain). The agencies decided to act more quickly on these higher priority OUs due to the potential human health and environmental risks posed by these OUs. The remaining OUs – OU-2 (Pit Lake), OU-4b (Sulfide Tailings), OU-5 (Waste Rock Dumps), and OU-6 (Oxide Tailings) – pose less risk to human health and the environment; work on these OUs will proceed once the priority OUs have finalized the RI and FS, Human Health Risk Assessment, Proposed Plans, and Records of Decision (RODs), and remedial actions have begun. The Arimetco OU-8 was deemed the most urgent because acidic drain-down fluids from the OU-8 heap leach pads (HLPs) continued to accumulate in the FMS evaporation ponds and the ponds are expected to reach capacity two to four years from now. Action is needed to prevent the ponds from overflowing and causing a release. Minor modifications to the Selected Remedy could occur during the remedial design phase in order to achieve more effective and efficient closure of OU-8 features.

The Selected Remedy addresses source materials (drain-down fluids) constituting principal threats by reducing the generation of those fluids via capping and reducing their mass via evaporation.

The Selected Remedy includes the following components:

- Fluids management. Continue existing fluid management system (FMS) operations and maintenance while new features or upgrades are implemented. Specifically includes active fluids collection, passive evaporation of pond fluids, HLP perimeter ditch rehabilitation and maintenance, wildlife deterrent measures for all ponds.
- Site access restrictions and engineering controls.
- Installation of evaporative covers on the entire surfaces of the HLPs.
- Conversion of some existing ponds to evaporation cells (E-cells).
- Closure of the 4-Acre Pond (removal and reprocessing or encapsulation)

1.5 Planning and implementation of stormwater management actions at OU-8 facilities Statutory Determinations

The Selected Remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate (ARARs) to the remedial action (unless non-compliance is justified by a waiver), is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. The Selected Remedy also satisfies the statutory preference for treatment through reduction of mobility and volume as a principal element of the remedy.

Because the Selected Remedy will result in hazardous substances, pollutants, or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, statutory review will be conducted no less often than every five years after initiation of remedial action to ensure that the remedy remains protective of human health and the environment.

1.6 Data Certification Checklist

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for this Site:

- Contaminants of concern (COCs) and their respective concentrations (Section 2.2)
- Baseline risk represented by the COCs (Section 2.2)
- Cleanup levels established for COCs and the basis for these levels (Section 2.3)
- How source materials constituting principal threats are addressed (Section 2.6)
- Current and reasonably anticipated future land and resource use assumptions used in the baseline human health risk assessment (BHHRA) and ROD (Section 2.1.6)
- Potential land and water use that will be available at the Site as a result of the Selected Remedy (Section 2.1.6)
- Estimated capital, annual O&M, and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 2.8)
- Key factor(s) that led to selecting the remedy (i.e., a description of how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.8)

1.7 Lead Agency and Supporting Agency Signatures

Approved by:

____

Currently Vacant, Assistant Secretary — Date
Policy, Management, and Budget
U.S. Department of the Interior, Bureau of Land Management

Approved by:

____

Angeles Herrera, Assistant Director — Date
Federal Facilities and Site Cleanup Branch, Superfund Division
U.S. Environmental Protection Agency, Region 9

Approved by:

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Greg Lovato, Administrator — Date
Nevada Division of Environmental Protection

The Decision Summary

The Decision Summary provides an overview of the site characteristics, alternatives evaluated, and the analysis of those options. It also identifies the Selected Remedy and explains how the remedy fulfills statutory and regulatory requirements.

1.8 Project Background

This section provides a brief description and history of the Site, including a summary of enforcement activities.

1.8.1 Site Name, Location, and Brief Description

The Anaconda Copper Mine Site (Site) (EPA #NV083917252) covers more than 3,400 acres in the Mason Valley, near the city of Yerington, in Lyon County, central Nevada, approximately 65 miles southeast of Reno. The Singatse Range and the town of Weed Heights lie to the west, open agricultural fields and homes to the north, Bureau of Land Management (BLM) managed public land to the south, and the Walker River and the city of Yerington to the east. Currently, EPA and BLM are the lead agencies and the NDEP is the support agency; however, for Arimetco HLPs and evaporation ponds (OU-8) remedial plan implementation, the State will be the lead, and federal agencies in support roles. Most of the OUs (OU's 1-7) are PRP-lead, with the remaining OU-8 being fund-lead.

The Site is an abandoned copper mine. Former mining and operations remnants consist of an open pit, mill buildings, leach vats, process areas, tailing piles, evaporation ponds, HLPs and process solution storage ponds. The State of Nevada, with the support of the neighboring Indian tribe, requested EPA take the lead for the entire site, including the Arimetco orphan share, in 2004. Immediate needs include closing the former Arimetco HLPs and evaporation ponds (OU-8).

1.8.2 Site History and Enforcement Activities

This section provides a discussion of the site history, agency involvement and enforcement actions, and a summary of the interim remedial actions.

1.8.2.1 Site Mining History

Copper in the Yerington District was initially discovered in the 1860s, with large-scale exploration of the copper system occurring in the early 1900s when the area was organized into a mining district by Empire-Nevada Copper Mining and Smelting Co. Large scale mining operations began at the Site around 1918 as the Nevada Empire Mine. Anaconda Copper Mining Company acquired the Anaconda Mine property (Property) in 1941 and conducted active mining operations from 1953 through 1977. During Anaconda's twenty-five (25) year operational period, approximately 1.7 billion pounds of copper were produced, resulting in the generation of waste rock, tailings impoundments, and evaporation ponds. 400 acres of waste rock placed south of the pit, 900 acres of contaminated tailings and 300 acres of disposal ponds.

In 1977, Anaconda merged with a subsidiary of ARC (renamed the Anaconda Company). A decrease in copper prices, lower priced foreign imports, and declining grade and amount of ore available forced the closure of Anaconda's copper mining operations in 1978. Anaconda Company was merged into ARC in 1981. Activities were shut down in 1982. Groundwater pumping out of the pit stopped when Anaconda operations ceased, resulting in the 180-acre Pit Lake forming. The pit is approximately 1 mile long and 800 feet deep. The current water depth is 500 feet, and the water level is increasing at a rate of approximately 1.3 feet per year. The Pit Lake contains approximately 40,000 acre-feet of water.

In 1982, ARC sold its interests in the Property to Don Tibbals, a local resident who leased the

Site to a small mining operation. In 1989, all of the former Property was sold, with the exception of the Weed Heights community, to Arimetco. Arimetco operated their HLP copper recovery operation using existing ore at the Site and ore from the MacArthur Pit from 1989 to 1999, at which time it ceased all mining operations. The area of former Arimetco operations comprises approximately 250 acres within the entire 3,400-acre Property. During Arimetco's operation of the Site, four phases of HLP construction were completed. High density polyethylene liners were installed under most of the HLPs to collect leachate that was transferred to collection ponds comprising twelve (12) acres and then conveyed at flow rates exceeding 5,000 gallons per minute (gpm) to the solvent extraction and electrowinning (SX-EW) plant for processing.

1.8.2.2 Arimetco Operational History

In 1988, Arimetco bought the property from Tibbals. Arimetco pursued leaching operations on the Site, eventually building an SX/EW plant and five HLPs to produce copper. Arimetco used tailings material left by Anaconda and added some new ore resulting in 250 acres of heap leach piles and 12 acres of heap leach solution collection ponds.

Arimetco did not use the historic Anaconda process facility; rather it constructed a new processing facility on the south side of Burch Drive. Copper was processed from Anaconda dump ores using conventional heap leaching and SX/EW technology. Approximately 40,000 tons of copper ore per day were hauled to the HLPs and dumped into 20-foot lifts. Each lift was leached for 30 to 40 days.

Arimetco's heap leaching process applied an acidic, water-based solution over the heaped ore surface. The solution (raffinate) contained approximately 1.2 percent sulfuric acid. The solution drained through the HLPs, leaching copper oxides as it permeated the ore. The resultant pregnant leach solution (PLS) that emerged at the toe of the HLP contained elevated concentrations of elemental copper and reduced amounts of sulfuric acid. The PLS was collected and delivered to the SX facility in flows that normally exceeded 5,000 gallons per minute (gpm). In the EW process, copper was electroplated to stainless steel sheets to produce 99.999 percent fine copper. Arimetco recirculated the acid solution from the EW vats back to the HLPs.

Arimetco went bankrupt in 1997, stopped adding acid and mining minerals to the HLPs in November 1998, ceased all processing in November 1999, and abandoned the Site in 2000. The State of Nevada took control of the Site on January 27, 2000. Upon cessation of Arimetco's activities, there was an estimated 90 million gallons of PLS present in the HLPs. The flow rate in the pumping system during January 2000 was approximately 1,200 gpm. Based on recent visual observations, the current average annual flow rate for all of the HLPs is estimated to be 10.6 gpm (Table 1).

In 2005, Quaterra Resources, Inc. (Quaterra), a Canadian mining company, optioned mining claims on the MacArthur copper oxide deposit north of the Site and began a multi-phase drilling program to develop the mining property. This mineral deposit had been the source of a significant amount of the ore used in the Arimetco operations. Following the success of their initial exploration effort, in February 2007, Quaterra established Singatse Peak Services (SPS), a wholly owned subsidiary, to further explore the copper potential of the Yerington area. In April 2011, SPS purchased the Arimetco holdings at the Site from the bankruptcy court and expanded drilling operations. In 2014, Quaterra signed an agreement with Freeport McMoran Minerals to purchase up to 75 percent of the mineral resources developed at the Site. Freeport McMoran is continuing to explore the property in partnership with Quaterra and SPS (Quaterra, 2016).

1.8.2.3 Agency Involvement at the Site

In 2002, NDEP and ARC entered into a consent agreement (2002 NDEP AOC) intended to accomplish the immediate investigation and mitigation of acute hazards at the Site. Through this consent agreement, ARC initiated many Site stabilization activities, such as managing the FMS to prevent discharges of acidic water (described fully in the following section).

On March 28, 2002, EPA, BLM, and the NDEP entered into a MOU regarding the Site. The MOU was intended to facilitate a process to implement RIs and any necessary response actions at the Site and provide roles for each of the agencies. Pursuant to the MOU, NDEP facilitated oversight between the three agencies, and EPA and BLM provided assistance, resources, and concurrence on deliverables.

On December 10, 2004, NDEP sent EPA a letter requesting that EPA formally assume the lead role at the Site with NDEP as support agency. On December 20, 2004, EPA responded to NDEP's letter and accepted the lead role. Since then several interim response actions have been performed, with ARC and EPA assuming the costs of those actions.

Since changing the lead for the Site, the agencies determined that they would abandon the MOU process and that EPA would assume the lead role as typically characterized in the NCP. To continue progress on the RI and response to acute hazards, on March 31, 2005, EPA issued to ARC a unilateral administrative order that included in its scope of work those tasks that ARC already was obligated to perform under the NDEP consent order, including operation of the FMS. The 2005 Unilateral Administrative Order (UAO) also compelled some additional tasks that EPA determined to be immediately necessary (described in the following section).

The additional tasks required in the 2005 UAO beyond the operation of the Arimetco FMS, as required in the 2002 NDEP AOC with ARC, consisted of (a) establishing and maintaining site security, which resulted in the construction of a fence along the site perimeter, (b) evaluating health and safety protocols addressing radiological contaminants for site workers, (c) implementing ambient air monitoring for radiological contaminants in the process areas and at the site perimeter, (d) implementing a radiological survey of the site and adjacent areas, (e) preparing an interim operations and maintenance plan and continuing ongoing response actions, monitoring, data collection and maintenance activities specified in the 1985 NDEP Administrative Order to ARC (NDEP, 1985), (f) continuing ongoing field activities, monitoring, data collection and maintenance as required in the 2002 MOU with EPA, NDEP and BLM such as sampling domestic wells, providing bottled water on request and investigating the process areas. On August 31, 2016, EPA, BLM, and NDEP signed a new MOU for the Site, which officially superseded the 2002 MOU. The new MOU established that EPA would be the lead agency on any response actions on the private land in the Site or when a potentially responsible party conducted any response actions and that BLM would be the lead agency for any BLM managed lands on the Site, except when a response action was to be conducted by a potentially responsible party in which case the lead agency role would revert to EPA. In the August, 2016 MOU, NDEP is responsible for the administration and enforcement of the Nevada Water Pollution Control Law and the Nevada Hazardous Waste Law, and the MOU calls for the coordination of the actions between the three agencies (EPA, BLM, and NDEP). This new MOU was preceded and supported by an additional MOU between EPA and BLM signed on June 28, 2016, which established the lead roles and required that EPA and BLM would jointly approve any response actions. The August 2016 MOU designates NDEP as a support agency and specifies that NDEP provides concurrence on behalf of the State of Nevada for any proposed remedial action, and is designated as the lead agency for implementing the Selected Remedy.

As noted, in the August 2016 MOU, EPA is designated the lead agency for response actions on private lands and BLM is designated the lead agency for response actions on BLM managed lands, except when a response action was to be conducted by a potentially responsible party. However, under the MOU different lead roles may be established by separate agreement, including giving NDEP a lead role pursuant to a State Superfund Contract or Cooperative Agreement. Actions would be coordinated and any disputes would be elevated to EPA, BLM, and NDEP management for resolution.

1.8.2.4 Enforcement Actions and Interim Remedial Action Summary

EPA has worked with ARC at the Site for approximately 15 years. Over that time, EPA has issued two unilateral orders - one on March 31, 2005 and one on January 12, 2007 - which, taken together, required the preparation of remedial investigations/feasibility studies for the Site's various operable units, and EPA has entered several administrative cost recovery settlements with ARC. Thereafter, EPA sought to negotiate the final resolution of cleanup cost responsibility with ARC. However, EPA has not been able to reach final agreement with ARC because larger issues with the Site, including addition of the Site to the NPL and the potential divisibility of the Arimetco contamination, have complicated the negotiations.

OU-8 interim remedial measures performed include the following:

- 2000—NDEP capped a partially constructed Arimetco Pond to mitigate "red dust" exposed during earlier construction.
- 2003—NDEP removed 400 drums and fluids remaining in the Arimetco facility.
- 2006—EPA constructed a 4-acre evaporation pond to contain excess drain-down fluids from the Arimetco Heap Leach FMS. EPA also mitigated dust blowing off site from the sulfide tailings and removed transformers containing polychlorinated biphenyls.
- 2007—EPA conducted a removal action to address fluid management issues associated with the Phase III Bathtub Pond located south of the Phase III South Heap Leach Pad, along with conducting a radiological removal assessment in the Process Areas.
- 2008—EPA removed the Mega Pond, two Raffinate Ponds, and the PLS Pond from the Arimetco FMS.
- 2008—EPA removed two organic traps and excavated kerosene contaminated soil and implemented bioremediation to address contaminants in the area of the SX/EW plant.
- 2010—EPA removed asbestos from the Anaconda Copper Mine office and disposed of the asbestos material off site, demolished the mine office, disposed of the demolition debris at an on-site landfill, radiologically screened 300 large truck tires and disposed of them off-site, removed containers of hazardous waste left on site, repaired portions of the Arimetco FMS, and assessed enhanced evaporation methods for the evaporation ponds.
- 2012—EPA along with SPS, the current private land owner of the Site, upgraded the VLT Pond portion of the Arimetco FMS and EPA directed ARC and SPS to evaluate improving the storage capacity of the FMS.
- 2013—NDEP installed two ponds (B and C), with funding from EPA and ARC, next to the existing 4-acre evaporation pond to increase the storage capacity of the FMS as was recommended in the ARC/SPS study.

Other Anaconda interim remedial measures performed included the following:

- 2001—NDEP capped three areas of calcines (mineral processing residuals) to mitigate fugitive "red dust."
- 2002—NDEP capped the Thumb Pond to mitigate fugitive "red dust."
    - 2007—ARC completed installation of approximately 3.5 miles of new fencing, new gates, and new signage, and repairs of 10.7 miles of existing fencing, to prevent unauthorized access to the site.
- 2009—ARC, under direction from EPA, capped areas of the evaporation ponds, removed 6,000 tons of radiologically contaminated soils from the Process Areas, removed transite/asbestos pipe, and abated electrical hazards.

- 2010/2011—ARC, under direction from EPA, applied dust suppressant to a portion of the Process Area and the Thumb Pond.

1.8.3 Community Participation

Community involvement activities have been ongoing at the Site since 2002. As a requirement of the 2002 MOU between NDEP, BLM, and EPA, ARC was required to prepare a Community Relations Plan (CRP). The purpose of the CRP was to provide for appropriate information exchange between the public, other stakeholders and members of the Yerington Technical Work Group, which consisted of the following entities:

- ARC
- NDEP
- BLM
- EPA
- U.S. Fish and Wildlife
- U.S. Bureau of Indian Affairs
- Yerington Paiute Tribe
- Walker River Paiute Tribe
- Lyon County
- City of Yerington
- Office of U.S. Senator Harry Reid
    - Yerington Community Action Group

The *Community Relations Plan for the Yerington Mine Site, Lyon County, Nevada* (Brown and Caldwell, 2002) was prepared in accordance with the public participation requirements in CERCLA and the NCP Section 300.430(f)(3). The CRP identified communication tools including the following:

- Factsheets
- Community meetings
- City Council County Commissioners updates
- Site website
- Information Repository at the Lyon County Library
- Preparation of a specific Administrative Record for each proposed cleanup action
- Developing a mailing list for the distribution of factsheets and meeting notices
- Publishing public notices in the local media

In March 2011, the Community Involvement Plan (CIP), prepared by EPA, replaced and updated the CRP. The *Draft Community Involvement Plan, Anaconda Mine Superfund Site, Yerington, NV* (EPA, 2011) is currently in the process of another update. The agencies conducted community and stakeholder interviews in August 2016, which will inform the updated version of the plan.

EPA continues to implement the 2011 CIP by holding regular community meetings to update the public and working closely with stakeholder groups, including the Tribes and community organizations. EPA is committed to holding at least one community meeting/information session per year, along with issuing fact sheets and providing information via radio broadcasts and/or newspaper articles. EPA also maintains community relationships through informal phone conversation and email updates to interested stakeholders.

Since EPA met with the State Land Use Planning Advisory Council in Yerington on October 14, 2005, EPA has solicited input regarding anticipated future land use and beneficial uses of groundwater from the community and local and state government. The October 14, 2005, meeting was followed up with meetings with the Lyon County Commissioners and Yerington City Council in September 2006, and discussions with the Mason Valley Environmental Committee in June and November 2006. On January 21, 2010, EPA presented a Reuse Assessment to the Lyon County Commissioners and Yerington City Council. The proposed reuse put forward was that the site be used for mining, if that was found to be feasible. The following uses were also proposed: light industrial; industrial; commercial-primarily offices; recreational specifically for off-road vehicle or motor-cross. EPA also suggested the land could be used for solar power generation. The site is zoned industrial with no residential uses by Lyon County.

The *Final Feasibility Study for Arimetco Facilities Operable Unit 8, Heap Leach Pads and Drain-down Fluids, Anaconda Copper Mine* (CB&I, 2016a) and the Proposed Plan (EPA, 2016a) were made available to the public in November 2016. These documents can be found in the Administrative Record file, and in the information repositories maintained at the Superfund Records Center in EPA Region 9 and at the Lyon County Library in Yerington, Nevada. The notice of availability of the Proposed Plan was published by NDEP on November 19, 2016, and by BLM on November 21, 2016, in the Mason Valley News and Reno Gazette-Journal. The public comment period was held for 30 days, from Monday, November 21, 2016 to Wednesday, December 21, 2016. Two public meetings were held on December 12, 2016 (2:30 to 4:30 pm and 6:00 to 7:30 pm), to present the Proposed Plan to the public. At these meetings, NDEP presented the Proposed Plan to the attendees, and representatives from EPA, BLM, and NDEP answered questions about the Site and the remedial alternatives, and the agencies solicited input on the remedy.

Throughout the development of the remedial alternatives, EPA, along with BLM, has undertaken consultation with the Tribes consistent with EPA policies. EPA conducted formal consultation with the Tribes upon issuance of the Proposed Plan, including presentations and discussions with tribal council and tribal members at the Walker River Paiute Reservation and the Yerington Paiute Reservation on December 13 and 14, 2016, respectively. NDEP presented the Proposed Plan to the Walker River Paiute Tribe (WRPT) at that tribal consultation and fielded questions by tribal council representatives. EPA provides Superfund Support Agency Cooperative Agreements to the Tribes in support of technical discussions at the Site.

EPA's responses to the comments received during the public comment period are included in Section 3.0.

1.8.4 Scope and Role of the Response Action

A large mining site, such as the Anaconda Copper Mine, has multiple types of environmental contaminants resulting from the past mining processes and site history. To address the multiple complex problems at the Site, in 2005, EPA organized the work into eight OUs:

- Site wide Groundwater (OU-1)

  — Addresses the contamination of the groundwater aquifer throughout the Site including the groundwater beneath the Pit Lake, Process Areas, Evaporation Ponds/Sulfide Tailings, Waste Rock Areas, Oxide Tailings, Wabuska Drain, and Arimetco Facilities, as well as off-site groundwater migration and transport.

- Pit Lake (OU-2)

  — Addresses the contaminated surface water within the Yerington Pit Lake, which formed in the open-pit from the mining operations.

- Process Areas (OU-3)

  — Addresses the contamination in the soil and within the facilities in the area that Anaconda used to process the copper ore at the Site.

- Evaporation Ponds/Sulfide Tailings (OU-4)

  — Addresses the contamination in the residual sediments deposited in the evaporation ponds from the mining processes (4a) and the tailings resulting from the copper sulfide ore processing (4b).

- Waste Rock Dumps (OU-5)

  — Addresses the contamination in the Waste Rock piles that resulted from the open-pit copper mining at the Site.

- Oxide Tailings (OU-6)

    — Addresses the contamination remaining in the tailings, which were the result of processing the copper oxide ore at the Site.

- Wabuska Drain (OU-7)

    — Addresses the contamination in the soil beneath and adjacent to the Wabuska Drain, which drained the residual fluids leaking from the Sulfide Tailings, which were conveyed northward through Mason Valley and towards the Walker River.

- Arimetco Facilities (OU-8)

    — Addresses the contamination remaining in the Arimetco five HLPs (Phase I/II, Phase III South, Phase III 4X, Phase IV Slot, Phase IV VLT), associated drain-down fluids management system (including ponds and ditches that store ad convey drain-down solution), SX/EW plant used to process the drain-down fluids, and historical spills from operational activities.

EPA, NDEP, BLM, and ARC have discussed the overall Site priorities, and have prioritized the OUs at the Site. It was determined that the highest priority OUs include OU-8, OU-1, OU-3, OU-4a, OU-7.

The agencies decided to act more quickly on these higher priority OUs due to the potential human health and environmental risks posed by these OUs. The remaining OUs (OU-2, OU-4b, OU-5, and OU-6) pose less risk to human health and the environment. Work on these OUs will proceed once the priority OUs have finalized their RI/FS, human health risk assessments (HHRAs), proposed plans, and RODs and remedial actions have begun.

The agencies and ARC have also discussed possible variations to the current OU designations that may provide more effective closure or remedial actions in specific areas of the overall site, including current OU-8 facilities. As the current priority OUs progress and OU-8 remedial design nears initiation, decisions will be made on OU boundaries and connections to ensure that remedial action effectiveness is achieved while maximizing efficiency of field mobilization efforts when possible and consistent with the selected remedial action for OU-8.

This ROD addresses the remedial actions for the pollutant and contaminant sources associated with the five HLPs and the FMS that are components of OU-8. It does not address the pollutant and contaminant sources associated with the SX/EW Plant and the historical spill areas. The contaminated groundwater associated with the Arimetco facilities will be addressed as part of the RI/FS and remedial actions for site wide groundwater contamination in OU-1. Further study is required to define the nature and extent of contamination derived from the SX/EW Plant and historical spill areas. These OU-8 pollutant and contamination sources will be addressed in an additional RI/FS and ROD amendment for OU-8. This ROD and any future OU-8 ROD amendment will be consistent. The agencies also recognize the potential to combine actions from different OUs into the same ROD(s) or other appropriate decision documents including removal action decisions.

1.8.5 Site Characteristics

A conceptual site exposure model has been developed to identify exposure pathways through which contaminants in environmental media come into contact with human receptors (Figure 5). The conceptual site exposure model consists of: contaminant sources; primary release mechanisms; and potential transport media, exposure medium, routes of exposure, and receptor groups associated with the Site.

The conceptual site model presents exposure pathways for COCs in OU-8 HLP materials, drain-down fluids, and surface water. OU-8 surface water includes drain-down fluids, seasonal water pooled in low lying areas and evaporation ponds resulting from surface water runoff, rainfall, snowmelt, seeps, or irrigation. Potential exposure to groundwater is not evaluated as part of the assessment for OU-8. It will be evaluated as part of risk assessments that will be performed for OU-1.

The exposed populations include the following:

- on-site outdoor workers
- on-site construction workers
- on-site indoor workers
- on-site trespassers
- off-site residents
- off-site tribal receptors
- off-site agricultural receptors

The exposure pathways evaluation includes direct contact (incidental ingestion and dermal contact) with HLP materials; external radiation; and inhalation of dust in ambient air from HLP materials by on-site outdoor workers, on-site construction workers, and on-site indoor workers.

For trespassers, evaluation includes incidental ingestion, external radiation, and inhalation of dust in ambient air from HLP materials.

For an on-site worker, exposure to drain-down fluids or surface water in ponds, basins, and ditches is likely to be accidental or very brief because drain-down fluids are contained in lined ponds or ditches that have steep slopes or other features that limit or discourage contact; therefore, this pathway was qualitatively evaluated.

1.8.5.1 Physical Setting

The Site is located in a high desert environment characterized by an arid climate. Monthly average temperatures range from 33.4 degrees Fahrenheit in December to 75.2 degrees Fahrenheit in July. Annual average rainfall for the city of Yerington is 4.8 inches per year, with lowest rainfall occurring between July and September (Western Regional Climate Center, 2012). Wind speed and direction at the Site are variable because of natural conditions and variable topographic features created by surface mining operations. Meteorological data collected since 2002 indicate that the dominant wind directions are to the north and the northeast (Brown and Caldwell, 2008). The Walker River flows northerly and northeasterly between the Site and the city of Yerington.

1.8.5.2 Geology

The Site is located on the west side of Mason Valley, a structural basin surrounded by uplifted mountain ranges composed primarily of consolidated igneous rocks, Tertiary and Cretaceous in age. The primary ranges bordering the valley are the Singatse Range to the west, the Wassuk Range to the east, the Desert Mountains to the north, and the Pine Grove Hills to the south. Mason Valley is approximately 40 miles long (north to south) and ranges in width (east to west) from 9 miles in the south to an estimated 20 miles transecting the city of Yerington. The maximum elevations of the Wassuk and Singatse Ranges within Mason Valley drainage area are estimated at 9,000 and 6,000 feet respectively; while the maximum elevations in the Pine Grove Hills is an estimated 8,650 feet and the Desert Mountains about 6,710 feet (CH2M HILL, 2011b).

The mountain blocks are primarily composed of granitic, metamorphic, and volcanic rocks with minor amounts of semi-consolidated to unconsolidated alluvial fan deposits. The Singatse Range has been subject to metals mineralization, as evidenced by the large copper porphyry ore deposit at the Site (CH2M HILL, 2011b).

Unconsolidated alluvial deposits derived from erosion of the uplifted mountain block of the Singatse Range and alluvial materials deposited by the Walker River fill the Mason Valley in the vicinity of the Site. These unconsolidated deposits, collectively called the valley-fill deposits by Huxel (CH2M HILL, 2011b), comprise four geologic units: younger alluvium (including the lacustrine deposits of Lake Lahontan), younger fan deposits, older alluvium, and older fan deposits. Lake Lahontan lacustrine deposits appear to have been removed and reworked by the Walker River as it meandered across the valley (CH2M HILL, 2011b).

The geologic setting below the Site can be further described based on existing information and subsurface data obtained by the United States Geological Survey (USGS) in 1978 while drilling test wells north of the Site (Seitz et al., 1982). Alluvial fan deposits along the west margin of the valley and stream and lake sediments on the valley floor underlie the tailings and evaporation ponds. Based on the lithology of core samples collected during previous investigations, the alluvial fan underlying the Site comprises generally fine-grained mudflow deposits and coarser-grained channel deposits.

1.8.5.3 Hydrogeology

The Site is located on the distal edge of an alluvial fan, between the Singatse Range and fluvial deposits associated with the Walker River. The source area for the fan is a major drainage feature referred to as "The Canyon" on the USGS 7.5-minute Yerington ConcDP-quadrangle (CH2M HILL, 2011b). The head of The Canyon is shown near Singatse Peak at approximately 6,000 feet above mean sea level (amsl). The Canyon runs approximately 2 miles south and east to the head of the alluvial fan at approximately 4,800 feet amsl; the base is between 4,380 and 4,420 feet amsl. The Site is approximately 1 mile down slope from the head of the fan at approximately 4,450 feet amsl. The natural topography of the area has been altered by mining and milling operations.

Groundwater in the Mason Valley, particularly near the former mine site, occurs in two predominant units: the alluvium and the bedrock.

1.8.5.4 Surface Water

Regional surface water features include the Yerington Pit Lake, the Walker River, and a series of ditches and drains used to distribute water to various agricultural interests throughout the Mason Valley. Surface water hydrology at the Site is controlled by its location on the distal edge of an alluvial fan and the significant surface development that has occurred at the Site. A comprehensive evaluation of stormwater hydrology throughout the Site has not been attempted.

1.8.5.5 Seismicity

The State of Nevada is located within the Basin and Range Province, one of the most seismically active regions in the United States, and ranks in the top three U.S. states subject to the largest earthquakes over the past 150 years.

Five generally north-south trending planar rotation faults transect the Site (CH2M HILL, 2011b), including the Sales, Bear, Montana-Yerington, Range Front, and Sericite Faults.

The most recent seismic activity near the Site occurred approximately 14.4 miles (23 kilometers) southwest of Smith Valley. Twenty-four small earthquakes within a 31-mile (50-kilometer) radius of the Site occurred between January 2014 and May 2014, with magnitudes ranging from

1.1 to 2.5 at depths from 1.9 to 14.1 kilometers. The USGS produced maps from an extensive database that provide probabilistic ground accelerations for a given site. The probabilistic seismic hazard at the Site was obtained from the USGS Earthquake Hazards Program website (http://earthquake.usgs.gov/hazards/apps/map). There is a 10% probability in 50 years of experiencing a peak ground acceleration of 0.24 acceleration of gravity (g) with a recurrence interval of 475 years, a 2% probability in 50 years of experiencing a peak ground acceleration of 0.50 g with a recurrence interval of 2,475 years and a 1% probability in 50 years of experiencing a peak ground acceleration of 0.66 g with a recurrence interval of 4,975 years.

1.8.5.6 Ecological Setting

The natural ecological habitat throughout much of the Site has experienced significant disturbance as a result of mining and milling operations. Other areas are less severely disturbed and retain areas of sandy soil interspersed with vegetation typical of the sagebrush-steppe vegetative mix of shrubs, forbs, and grasses indicative of the Basin and Range physiographic province. No federal or state-listed special status species (e.g., endangered or threatened species) are known to occur at the Site.

The primary natural aquatic feature proximal to the Site is the Walker River, which flows north-northeast between the Site and the town of Yerington. Although riparian systems comprise an extremely small fraction of the Great Basin region, they are critical centers of biodiversity; more than 75 percent of the species in the region are strongly associated with riparian vegetation (CH2M HILL, 2011b). The Walker River is typical of Great Basin riparian systems, which are dominated by woody plants (i.e., cottonwood, aspen, willow). The riparian corridor of the Walker River provides habitat for resident and migrating wildlife. The proximity of the Site to the Walker River may increase wildlife use of the Site.

Activities at the Site have resulted in the generation of aquatic areas that could attract wildlife, including the Pit Lake, wastewater treatment ponds, pump-back evaporation ponds, and the unlined evaporation ponds that seasonally retain water. The drain-down ponds and lined evaporation ponds continually have drain-down fluids that also attract wildlife. These features provide drinking water for wildlife at the Site, resting areas for migratory birds, and a source of emergent vegetation for forage and cover for migrating and resident wildlife. OU-8 ponds and sizable water features have had bird deterrence measures installed to minimize the risks to avian wildlife; these measures are operated and maintained by ARC.

1.8.5.7 Potential Contamination Sources

An extensive sampling program was initiated at the Site in 1999 when a limited sampling effort found elevated uranium in the groundwater north of the Site. Starting in 2005, after assuming the lead role at the Site, EPA initiated an RI/FS in accordance with CERCLA and NCP requirements focusing on sampling soil, groundwater, air, and airborne dust. EPA designated eight OUs, set media specific screening levels for each OU and identified potential action levels. Borehole locations were randomly selected by using a polygon overlay of the upper decks of the HLP groups – A and B. Group A includes the contiguous Phase I/II, Phase III South, Phase III 4X and Phase IV Slot HLPs. Group B specifically refers to the Phase IV VLT HLP, which is comprised almost exclusively of processed VLT and oxide tailing materials. Drain-down solution samples were collected to obtain baseline data from HLP perimeter ditches and ponds. Primary contaminants of concern include metals (arsenic, chromium, and copper), low pH, and radioisotopes (radium-228, and uranium-238). Media affected include the HLP materials and drain-down fluids. During Anaconda's twenty-five year operational period, approximately 1.7 billion pounds of copper were produced, resulting in the generation of waste rock, tailings impoundments, and evaporation ponds. COC concentrations are provided in Table 4. Potential routes of migration and potential affected human populations are shown on Figure 5.

OU-8 includes pollutant and contaminant sources associated with the five HLPs (Phase I/II, Phase III South, Phase III 4X, Phase IV Slot, and Phase IV VLT]), the FMS (including ponds

and ditches that store and convey drain - down solution), the SX/EW Plant, and historical spill

areas. HLP materials consist of run-of-mine, low-grade oxide ore or oxide tailings from crushers. The ore material or oxide tailings are composed of low-mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite and trace metal sulfides. Table 1 provides a summary of the Arimetco HLP construction details. The majority of currently active FMS components (ponds, pumps, and pipelines) were in-place during Arimetco operations. Modifications by NDEP and EPA since 2000 have improved system performance, eliminated areas with the potential for drain-down fluids to escape containment, and increased storage and evaporation capacity. Table 2 provides a summary of Fluid Management Pond design specifications.

Available data combined with knowledge of historical OU-8 activities indicate that mining-related contaminants associated with former Arimetco operations have adversely affected portions of the Site (CH2M HILL, 2011b). Areas affected by Arimetco operations include the footprints of each HLP and their associated drain-down FMS ditches, pipes and ponds, historical spill areas and the SX/EW Process Area. Based on groundwater monitoring results, these impacts are thought to extend vertically down to groundwater, although the relative contributions from Arimetco versus other site-related contaminant sources have not been determined (CH2M HILL, 2011b).

Characterization data have been collected and removal actions have occurred within OU-8 by EPA, NDEP, and others. To determine the usability and completeness of this work, a data gap analysis was completed, which included a thorough review of existing data and information relative to conditions that are known or suspected on the basis of archive reports, records, and field observations (CH2M HILL, 2011b).

Based on the Arimetco documents left behind following Site closure, within the archives and housed at NDEP, Arimetco appeared to be deficient in accurately estimating the quantities of fluid released, documenting the precise location of the releases, and recording the exact contaminants released. Therefore, there may be insufficient data from the previous field investigations to determine the nature and extent of contamination to the environment resulting from Arimetco mining and milling operations. As a consequence, this interim ROD does not address other pollutant and contaminant sources in OU-8 related to the SX/EW Plant and the historical spill areas. Further study is required to define the nature and extent of contamination derived from SX/EW Plant and historical spill areas. These OU-8 pollutant and contamination sources will be addressed in an additional RI/FS and ROD Amendment for OU-8.

1.8.6 Current and Potential Future Land and Resource Uses

In 1998, mining and ore beneficiation operations at the Site ceased. Facilities associated with copper mining operations at the Site include an open-pit mine, mill buildings, tailing piles, waste rock dumps, waste fluid ponds, and the adjacent residential settlement known as Weed Heights. A network of leach vats, heap leaching pads, and evaporation ponds remains throughout the Site.

Current activities include drain-down fluids management, routine O&M of wildlife deterrent systems, monitoring and periodic sampling of the groundwater well network and continuing RI/FS-related work. Other than routine monitoring of groundwater, no investigations are currently occurring at the Arimetco facilities (OU-8).

No residential land use occurs on the Site. The closest off-site residential areas include residences on Luzier Lane (less than 100 yards away from the northern boundary of the Site), Locust Drive and the Sunset Hills residential area, a trailer park east of the Site and the community of Weed Heights. The southern boundary of the Yerington Paiute Tribe Reservation is located about 2.5 miles from the northern boundary of the historical mine property and OU-7 (Wabuska Drain) extends from the historical mine property through Yerington Paiute Tribe Tribal trust property to its confluence with the Walker River. The northern portion of the city of Yerington is adjacent to the eastern boundary of historical mine property.

The current landowners of OU-8 property, SPS and the United States, indicate that mining is a potential future use. The timing of this potential future use is dependent on uncertain economic factors, including the price of copper on the world market. If SPS determines that mining is not viable and vacates the mine property, other reuse options become more likely. Variable OU-8 topography is likely to limit building development on several areas, but there are level areas where future development could occur, which may bring people into contact with COCs. Mixed private and federal ownership of the land, along with the presence of contamination, limit re-development potential, due to federal restrictions associated with transfer of contaminated land. Input from the community gained as part of the Site Reuse Assessment for the Mine Property, completed by EPA in April 2010, indicates that there is a range of potential reuses for the Site property, with mining considered to be most likely. Current and future adjacent land uses include residential, agricultural, and light industrial and commercial uses.

Groundwater in the Yerington area is used for drinking water, agriculture, and livestock. ARC offers bottled water to residents with domestic wells north and west of the mine site whose groundwater exceeds federal drinking water standards for uranium. There are areas of surface water on the Site that could pose a threat to wildlife and groundwater resources. These areas are primarily contaminated with heavy metals and low pH levels. ARC has been monitoring wildlife since 2007 and operating bird deterrent systems at the Site's evaporation ponds and Arimetco ponds since 2008.

In 2005, Quaterra, a Canadian mining company, optioned mining claims on the MacArthur copper oxide deposit north of the Site and began a multi-phase drilling program to develop the mining property. This mineral deposit was the source of significant ore used in the Arimetco operations. Following the success of this initial exploration effort, in February 2007, Quaterra established SPS, a wholly owned subsidiary, to further explore the copper potential of the Yerington area. In April 2011, SPS purchased the Arimetco holdings at the Site area from the bankruptcy court and expanded drilling operations. In 2014, Quaterra signed an agreement with Freeport McMoran Minerals to purchase up to 75 percent of the mineral resources developed at the Site. Freeport McMoran is continuing to explore the property and increase its share of the Site and works with Quaterra and SPS (Quaterra, 2016).

1.9 Summary of Site Risks

The baseline human health risk assessment (BHHRA) estimates what risks the Site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the BHHRA for this Site.

As part of the RI, the *Screening Level Human Health Risk Assessment, Arimetco Heap Leach Pads, Anaconda-Yerington Copper Mine, Yerington, Nevada* (SLHHRA; CH2M HILL, 2008) evaluated HLP surface material samples collected during October 2007 and drain-down fluid samples collected during September 2007. The SLHHRA used conservative screening criteria including residential and industrial preliminary remediation goals, drinking water maximum contaminant levels (MCLs), and tap water preliminary remediation goals.

In the SLHHRA (CH2M HILL, 2008), OU-8 HLPs were grouped according to similar HLP composition:

- Group A includes four HLPs
    - Phase I/II HLP
    - Phase III South HLP
    - Phase III 4X HLP
    - Phase IV Slot HLP
- Group B includes only the Phase IV VLT HLP

This evaluation concluded that for potential exposure in a residential scenario, Group A HLP materials would pose a risk at the upper end of the 10^{-6} to 10^{-4} cancer-risk range), and Group B HLP materials would pose a risk that exceeds 10^{-4} cancer risk. Tables in Appendix H of the Remedial Investigation Report (CH2M HILL 2008) present the risks and hazards from exposure to Group A and Group B HLP material. Industrial cancer risk was at the upper end of the 10^{-6} to 10^{-4} cancer risk range for both HLP groups. The noncancer health hazards for exposure to Group A HLP materials exceeded a hazard index (HI) of 1 for residential exposures, and for Group B HLP materials exceeded an HI of 1 for residential and industrial exposures. Drain-down solutions exceeded the drinking water MCLs for ten metals (arsenic, beryllium, cadmium, chromium, copper, lead, mercury, selenium, thallium, and uranium).

As part of the *Final Supplemental Remedial Investigation Report Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine* (CH2M HILL, 2011b), the *Supplemental Human Health Risk Assessment, Arimetco OU-8, Anaconda-Yerington Copper Mine, Yerington, Nevada* was prepared in 2010 (CH2M HILL, 2010), which evaluated the following:

- Surface and mixed-zone soil samples collected from SX/EW Process Area during August through September 2009
- Groundwater
- Drain-down fluids samples collected during September 2009 through March 2010

This evaluation concluded that residential and industrial cancer risk estimates for surface and mixed-zone soil in the SX/EW Process Area were within the 10^{-6} to 10^{-4} cancer risk range. The noncancer health hazards for exposure to surface and mixed-zone soil exceeded an HI of 1 for residential and industrial exposures. Drain-down solutions exceeded the drinking water MCLs for 10 metals (arsenic, beryllium, cadmium, chromium, copper, lead, mercury, selenium, thallium, and uranium). The cumulative cancer risk for potential exposure to groundwater under a residential scenario exceeded 10^{-4} cancer risk. The noncancer health hazards for exposure to groundwater exceeded an HI of 1 for residential exposure.

The screening level HHRA and the supplemental screening level HHRA were combined and finalized into the baseline HHRA (CB&I, 2016).

1.9.1 Human Health Risk Summary

1.9.1.1 Identification of Chemicals of Concern

The COCs were determined to be those contaminants that exceeded a cancer risk of 10^{-6} (the target risk level of 10^{-6} is used to accommodate multiple contaminants at the site and multiple pathways of exposure, as recommended in the National Oil and Hazardous Substances Pollution Contingency Plan) or exceeded noncancer hazard quotients (HQs) of 1 and where the maximum detected concentration exceeded the background maximum detected concentration. The background soil data referenced in the *Background Data Summary Report, Yerington Mine Site, Revision 1* (ARC, 2009) for two subareas (Subarea A-1 and Subarea A-2) were used in this BHHRA. The background soil samples were collected at 2 to 10 inches bgs and 2 to 3 ft bgs. Background concentrations for arsenic and chromium exceed RSLs. The constituents selected as COCs include arsenic, chromium, copper, cobalt, radium-228, and uranium-238. COCs for the drain-down fluids include arsenic, chromium, and uranium. A summary of the COCs for each exposure area is provided in Table 3.

Table 4 presents a summary of the COCs, their associated concentrations in each HLP material and drain-down fluids, and their frequency of detection. The table includes the range of concentrations detected for each COC, as well as the frequency of detection (i.e., the number of times the chemical was detected in the samples collected at the Site), the exposure point concentration (EPC), and how the EPC was derived. The maximum concentration was used as the EPC for radionuclides and drain-down fluids due to the small number of samples in each data grouping.

1.9.1.2 Exposure Assessment

The exposure assessment is used to identify and assess the means by which potential receptors at the Site might, under current land use conditions (i.e., maintenance) and from reasonably anticipated potential land uses, come into contact with chemicals of potential concern present in

OU-8 HLPs and drain-down fluids. The exposure assessment also identifies the receptors that might be exposed, the routes by which these individuals might become exposed, and the magnitude, frequency, and duration of potential exposures (Figure 5). This information was developed in the Conceptual Site Model (Figure 5). For complete details, the exposure assessment is located in Section 3.0 of the *Baseline Human Health Risk Assessment for Arimetco Facilities Operable Unit 8, Heap Leach Pads and Drain-down Fluids, Anaconda Copper Mine* (CB&I, 2016b).).

The exposed populations included the following:

- on-site outdoor workers
- on-site construction workers
- on-site indoor workers
- on-site trespassers
- off-site residents
- off-site tribal receptors
- off-site agricultural receptors

The exposure pathways evaluation included direct contact (incidental ingestion and dermal contact) with HLP materials; external radiation; and inhalation of dust in ambient air from HLP materials for on-site outdoor workers, on-site construction workers, and on-site indoor workers.

For trespassers, the evaluation includes incidental ingestion, external radiation, and inhalation of dust in ambient air from HLP materials. Dermal contact would likely be insignificant (more than approximately 1000 times lower than the risk from incidental ingestion) for trespassers; therefore, it was only qualitatively evaluated in this BHHRA.

For off-site residents, inhalation of dust in ambient air from HLP materials was evaluated quantitatively. Incidental ingestion, dermal contact, external radiation, and biota consumption would likely be significantly less for off-site residents than the other evaluated receptors; therefore, they were only evaluated qualitatively.

In addition, exposure to tribal receptors and agricultural receptors would likely be significantly less than other evaluated receptors through ingestion, dermal contact, external radiation, and inhalation of dust; therefore, they were only qualitatively evaluated in this BHHRA. Food sources would not grow on HLP material so were not evaluated as a complete exposure pathway. In addition, animals, including wild game, may wander in the OU-8 area. However, the exposure pathways involving ingestion of wild game or other biota by receptors outside of OU-8 remain incomplete because there is no forage on HLPs for consumption by wild game and animals do not consume liquids from ponds in OU-8 (CH2M HILL, 2011).

For an on-site worker, exposure to drain-down fluids or surface water in ponds, basins, and ditches is likely to be accidental or very brief because drain-down fluids are contained in lined ponds or ditches that have steep slopes or other features that limit or discourage contact. Construction, maintenance, and O&M work is required to be performed by on-site Occupational Safety and Health Administration and/or Mine Safety and Health Administration qualified workers whose training and experience would limit exposure to surface water hazards through implementation of a health and safety plan. Therefore, this pathway is only qualitatively evaluated in this BHHRA. The evaluation found that the drain-down fluids have low pH and contain high concentrations of metals, inorganics, and radionuclides. Any exposure would cause acute health effects.

1.9.1.3 Toxicity Assessment

The toxicity assessment evaluates the relationship between the magnitude of exposure to a chemical/radionuclide from the exposure area and the likelihood of adverse health effects on potentially exposed populations.

Table 5 provides carcinogenic risk information relevant to the COCs in the HLP material. Two of the COCs (arsenic and chromium) are considered carcinogenic via the oral route. All three of the COCs are carcinogenic via the inhalation route. Arsenic, chromium, and cobalt have inhalation unit risk factors of 4.3×10^{-3} (EPA IRIS 2016), 8.4×10^{-2} (EPA RSL Table 2016), and 4.3×10^{-2} (EPA PPRTV 2011), respectively. Note that slope factors are not available for the dermal route of exposure, thus, the dermal slope factors used in the assessment have been extrapolated from oral values. Adjustment factors are sometimes applied depending on how well the chemical is absorbed via the oral route. In this case, however, adjustments were not necessary for the chemicals evaluated.

Table 6 provides the toxicity parameters for radionuclides of concern. In accordance with *Preliminary Goals for Radionuclides User's Guide* (EPA, 2010), radionuclide toxicity values with daughter nuclides were used where applicable: R-228+D for radium-228 and U-238+D for uranium-238. Because the surrogates chosen are generally considered to have greater toxicity, the risk estimates for these constituents are likely conservatively high.

Table 7 provides non-carcinogenic risk information, which is relevant to the COCs in the HLP material. Four of the COCs have toxicity data indicating their potential for adverse non-carcinogenic health effects in humans. The chronic toxicity data available for arsenic, chromium, cobalt, and copper for oral exposures, have been used to develop oral reference doses (RfDs). The oral RfDs for arsenic and chromium are 3×10^{-4} mg/kg/day and 3×10^{-3} mg/kg/day, respectively (Source: IRIS, EPA, 2016). The oral RfDs for cobalt and copper are 3×10^{-4}

mg/kg/day (Source PPRTV, EPA, 2011) and $4x10^{-2}$, (Source HEAST, EPA 2016), respectively. The available toxicity data, from both chronic and subchronic animal studies, indicate that arsenic primarily affects the liver, cobalt affects the thyroid, and copper affects the gastrointestinal system. No target organ is indicated for chromium. Reference concentrations (RfCs) are available for arsenic, chromium, and cobalt. Similar to carcinogenic data, dermal reference doses (RfDs) can be extrapolated from the oral RfDs by applying an adjustment factor.

1.9.1.4 Risk Characterization

This section summarizes the approach used to develop the human health risk estimates for the Site and presents a quantitative risk characterization for OU-8 surface and mixed-zone HLP materials samples. HLP samples from each of the five HLP areas were grouped by sample depths:

- Surface HLP material (0.25 to 0.75 feet below ground surface [bgs])
- Mixed-zone HLP material includes subsurface composite samples (0 to 117 feet bgs with 0.25 to 0.75 feet bgs data included)

In this risk characterization step, quantification of risk is accomplished by combining the results of the exposure assessment (estimated chemical/radionuclide intakes) with the results of the dose-response assessment (toxicity values established in the toxicity assessment) to provide numerical estimates of potential health effects.

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

where: risk = a unitless probability (e.g., 2×10^{-6}) of an individual's developing cancer

CDI = chronic daily intake averaged over 70 years (mg/kg-day)

SF = slope factor, expressed as (mg/kg-day)-1.

These risks are probabilities that usually are expressed in scientific notation (e.g., $1x10^{-6}$). An excess lifetime cancer risk of $1x10^{-6}$ indicated that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. (American Cancer Society 2016). EPA's generally acceptable risk range for site-related exposures is 10^{-6} to 10^{-4}, meaning it is at least 10^{-6} and sometimes is as high as 10^{-4}.

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., life-time) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ<1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all chemical(s) of concern that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI<1 indicates that, based on the sum of all HQ's from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI>1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where: CDI = Chronic daily intake

RfD = reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

Because some metal concentrations are known to be higher in the region due to natural mineralization, background levels of metals could contribute to the total exposure and risk estimates for the HLP exposure areas. Therefore, it is important to determine what portion of the on-site concentrations detected is due to the site-related releases, compared to the portion representing background for the mine area. Background refers to the range of concentrations of the chemical in similar nearby reference areas that have not been affected by the Site activities. The incremental risks and hazards are reported as the difference between the on-site and the background estimates. Table 8 provides the incremental risks and hazards for each exposure area.

Table 8 provides risk estimates for the significant routes of exposure. These risk estimates are based on a reasonable maximum exposure and were developed by taking into account various conservative assumptions about the frequency and duration of exposure to HLP materials as well as the toxicity of the COCs arsenic, chromium, cobalt, copper, radium-228 and uranium-238. The total risk from direct exposure to contaminated HLP materials at this site to a current outdoor worker is estimated to be $5x10^{-5}$ (for Phase IV SLOT HLP). The COCs contributing most to this risk level are arsenic, chromium, radium-228 and uranium-238. The risk level indicates that if no clean-up action is taken, an individual would have an increased probability of 5 in 100,000 of developing cancer as a result of site-related exposure to the COCs.

Table 8 also provides hazard quotients (HQs) for each route of exposure and the hazard index (sum of hazard quotients) for all routes of exposure. The Risk Assessment Guidance (RAGS) for Superfund states that, generally, a hazard index (HI) greater than 1 indicates the potential for adverse noncancer effects. The estimated HI of 2 (for Phase III 4X, Phase IV SLOT, and Phase IV VLT HLPs) indicates that the potential for adverse noncancer effects could occur from exposure to contaminated HLP materials containing arsenic, chromium, radium-228 and uranium-238.

For an on-site worker, exposure to drain-down fluids or surface water in ponds, basins, and ditches is likely to be accidental or very brief because drain-down fluids are contained in lined ponds or ditches that have steep slopes or other features that limit or discourage contact; therefore, this pathway was qualitatively evaluated. A qualitative evaluation is an evaluation of the relationship between environmental exposures and the presence of an adverse effect in exposed human populations (EPA 1989). A qualitative evaluation typically involves comparison of contaminant concentrations to screening levels but does not calculate exposure dosage.

The drain-down fluids have low pH and contain high concentrations of metals, inorganics and radionuclides. The drain-down fluids are acidic with pH values between 1.9 and 3.3, which is similar to the pH of common beverages (Journal of American Dental Association [JADA] 2016)--. Although the likelihood for exposure by this scenario is minimal, any direct contact could potentially injure the eyes or skin. The World Health Organization has said that a pH of less than 4.5 can cause eye and skin irritation, and exposure to a pH of less than 2.5 can cause irreversible and extensive damage to epithelium (outer layer of cells of skin and eye). The pH measurements for drain-down fluid ponds are as follows:

- Phase I/II Ponds (1.9 to 3.07)
- Slot Pond (2.16-3.19)
- VLT Pond (2.5 to 3.3)
- EPA 4-acre Pond (2.66 to 2.82)

The pH levels in drain-down fluid ponds are almost all equal or below 2.5, thus, some eye injury could occur if this fluid contacted eye or skin of an on-site worker or trespasser.

Regarding the agricultural pathway, exposure to radionuclides from consumption of crops irrigated by groundwater and potentially affected by wind-blown dust is likely to be insignificant.

Based on one limited sampling event, uranium concentrations found in agricultural samples of onion from an adjacent field (CH2M HILL, 2009) were found to be less than concentrations generally found in onions. Onions were sampled because they were grown in a field adjacent to the site. Uptake of various metals including uranium can vary from plant type to plant type. Additionally, the relatively low uranium concentrations measured in onions may not be similarly low in other agricultural crops. However, given the relative distance from the OU-8 HLPs to the property boundary, and given the containment features for OU-8 fluids, it is considered highly unlikely that contaminants related to OU-8 would cause significant exposure through the agricultural pathway.

2.2.1.5 Uncertainty Analysis

Uncertainties, which arise at every step in the risk assessment process, are evaluated to provide an indication of the relative degree of conservatism associated with the risk estimate.

Radiological risks are underestimated due to limited radionuclide data, lack of radium-226 data in HLP materials, and radium-228 data in drain-down fluids. Also because of the lack of radium-226 data in HLP materials, the radium-226 background data were excluded from the background risk calculations. As radium-226 data were not available in HLP materials and background data sets, the incremental risks associated with this radionuclide are not known. In addition, there are several radionuclides (including thorium and uranium) used in the Site risk estimates but background data were only available for radium-226 and radium-228. Incremental risks are overestimated due to this data gap; however, the amount of overestimation is expected to be minor.

Another data gap is that uranium chemical data is not available for the HLP materials. To quantitatively evaluate the noncancer effects of exposure to chemical uranium, concentrations of radiological uranium (in picocuries per gram) were converted to chemical uranium (in milligrams per kilogram) and hazard estimates were calculated using the residential regional screening levels (RSL) for uranium. Chemical equivalents of uranium-234, uranium-235 and uranium-238 were calculated and the HQs for each isotope were added together. The results indicated that the HIs for exposure areas are below the noncancer threshold of 1 so the impact of the omission of uranium on the HIs is minor. However, HIs presented in this BHHRA are underestimated.

Additionally, total petroleum hydrocarbons (TPH)-diesel, TPH-kerosene, and TPH-motor oil were also not included in the calculation of HIs. Surrogate toxicity information for these compounds has been available in the *Regional Screening Levels (RSLs)—Generic Table* (EPA, 2016b) since 2014. EPA recommends using the following surrogates: TPH-aromatics (medium) for TPH-diesel, TPH-aliphatics (medium) for TPH-kerosene, and TPH-aromatics (high) for TPH-kerosene.

HQs using a ratio of the maximum concentration of the TPH compounds and industrial RSLs were calculated. The results indicated that the HIs for exposure areas are below the noncancer threshold of 1 so the impact of the omission of TPH compounds on the HIs is minor.

Risks for construction worker and off-site residents are characterized using exposure duration of 1 year and 30 years respectively. However, workers may have been employed (5 to 20 years) or off-site residents may live in the area (up to 70 years) for durations longer than the exposure durations used in the BHHRA. If an exposure duration of 20 years were used for a construction worker, risks would be around an order of magnitude greater than the presented risks. For a resident, if an exposure duration of 70 years were used, risks would be double the risks presented in this BHHRA. Therefore, risks for construction workers and off-site residents may be underestimated. There is no effect of exposure duration on noncancer hazards.

1.9.2 Summary of Ecological Risk Assessment

A screening level ecological risk assessment (SLERA) was performed in 2008, to evaluate the potential for adverse effects on resident biota resulting from exposure to metals and radionuclides

in drain-down fluids and surficial HLP materials in portions of OU-8 as part of the *Final Remedial*

Investigation Report Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine (CH2M HILL, 2011a).

SLERA findings showed that elevated concentrations of multiple metals in surficial HLP

materials and in drain-down fluids potentially cause adverse effects on plants, invertebrates,

birds, and mammals that may be exposed. Based on the results of the SLERA, it was decided that an ecological risk assessment for the site was not necessary. Table 9 provides a summary of 2008 ecological screening results for HLP surface materials and drain-down solution.

SLERA findings revealed the following in surficial HLP materials:

- Six metals (aluminum, arsenic, copper, mercury, molybdenum, and selenium) exceeded the screening values for virtually all receptor groups, with 100 percent of the sample results exceeding screening values in many instances.
- Lead exceeded screening values for all receptors except soil invertebrates; antimony, cadmium, and zinc screening values were only exceeded in upper trophic-level receptors (i.e., birds and mammals); and total chromium and cobalt screening values were only exceeded in lower trophic levels (i.e., plants and soil invertebrates).
- Five metals (barium, beryllium, manganese, nickel, and silver) did not exceed any of the available screening values for any of the receptor groups, nor were screening values (biota concentration guides) exceeded for soil-based radionuclides.

Evidence suggests that the drain-down fluid in the collection ponds is adversely affecting birds. For example, the discovery and reported mortality of more than 10 birds between May 2010 and November 2011 resulted in implementing reconnaissance of on-site ponds twice daily and the installation of bird deterrents including wind dancers, amplified predatory birdcalls, and compressed air cannons.

Comparison of concentrations of metals and pH from the ponds to acute toxicity values from the literature suggested that pH, aluminum, and copper are at levels acutely lethal to both birds and mammals (CH2M HILL, 2011). This was supported by a 2007 study observing 78 percent mortality among mallards, attributed to copper toxicity, which were acutely exposed to a synthetic acid mine water that had a composition comparable to that present in the Arimetco ponds (Hooper et al., 2007).

1.9.3 Risk Assessment Conclusions

Based on the results of the SLHHRA (CH2M HILL, 2008), BHHRA, and SLERA, the response action selected in this ROD is necessary to protect public health, welfare, or the environment from actual or threatened releases of pollutants or contaminants from this Site, which may present an imminent and substantial endangerment to public health or welfare.

1.10 Remedial Action Objectives

protecting human health and the environment.

RAOs are medium-specific goals for

RAOs were developed for OU-8 to support

the development and evaluation of remedial alternatives. Table 10 presents the RAOs and general response actions for the protection of human health and ecological receptors. The RAOs for OU-8 focus on isolating the contaminant source, preventing contact with contaminant sources, and limiting further migration of metals contamination from source areas into surrounding soil, surface water, and groundwater.

The RAOs are:

1. Prevent ingestion/direct contact with heap leach pad materials and drain-down fluids containing COCs above human health risk-based levels.

This objective was established to protect workers at the property from potential exposure to contaminants in the HLP materials and drain-down fluids, which exceed the established risk-based levels. The current and reasonably anticipated land use is commercial mining activity.

The response actions addressing the HLPs and the FMS ponds will reduce the potential risk to acceptable levels by treatment and containment measures.

2. Minimize exposure to heap leach pad materials and drain-down fluids containing contaminants of ecological concern at levels that are harmful to ecological receptors

This objective was established to protect wildlife at the property from potential exposure to contaminants in the HLP materials and FMS ponds, which exceed the established risk-based levels. The current and reasonably anticipated land use is commercial mining activity.

The response actions addressing the HLPs and the FMS ponds will reduce the potential risk to acceptable levels by treatment and containment.

These first two objectives are source control objectives, which are established to protect humans and ecological receptors from mine residual materials. The final RAO is:

3. Prevent migration of drain-down fluids to groundwater at levels above federal MCLs.

This objective was established as an additional source control objective to prevent further degradation of groundwater. The groundwater aquifer is designated a beneficial use aquifer by the State of Nevada consistent with Class II groundwater under federal guidelines (EPA, 1986).

The response actions addressing the HLPs and the FMS ponds will reduce the potential risk to acceptable levels by treatment and containment. .

1.11 Description of Alternatives

The following subsections describe the four remedial alternatives EPA, BLM, and NDEP selected for final evaluation and were presented for public comment in the Proposed Plan (EPA, 2016a). In addition, No Action, an alternative included in the FS (CB&I, 2016a), is also provided as a baseline for comparison. EPA, BLM, and NDEP reached agreement on the recommendation of the Preferred Alternative: Alternative 4, "Modified Evaporation, Complete Capping of HLPs, Pond Conversion to E-cells, and Stormwater Management." Alternative 4 is also identified in this ROD as the Selected Remedy.

Each of the alternatives are described as follows:

- Alternative 0 (FS Alternative 1), "No Action Alternative"
- Alternative 1 (FS Alternative 2), "No Further Action Alternative"
- Alternative 2, (FS Alternative 6a), "Passive Evaporation and Top Capping of HLPs"
- Alternative 3, (FS Alternative 8a), "Passive Evaporation and Complete Capping of HLPs"
- Alternative 4, (FS Alternative 6a/8a), "Modified Evaporation, Complete Capping of HLPs, Pond Conversion to E-cells, and Stormwater Management"

Three additional alternatives developed and evaluated in the FS (CB&I, 2016a) were rejected for final consideration as non-compliant, less cost-effective, or impractical to implement. The FS is available in the information repositories and is part of the Administrative Record; more detail on these three-screened alternatives may be found in the FS.

1.11.1 Remedy Components

Table 11 provides a summary of the remedial alternatives considered in this ROD. The following subsections provide detailed descriptions.

1.11.1.1 Alternative 0 (FS Alternative 1), "No Action Alternative"

Consideration of a No Action alternative is required as a baseline for comparison with other remedial alternatives (EPA, 1988a) and to satisfy the NCP requirement for inclusion of a no action alternative among the options considered. All current activities at the Site related to Arimetco OU-8 would cease under this alternative, and there would be no remedy components to this alternative or associated time to construct, capital or operation and maintenance costs.

1.11.1.2 Alternative 1 (FS Alternative 2), "No Further Action Alternative"

Alternative 1 provides for continuation of the current operation and maintenance activities at OU-8 facilities. Current FMS operation consists of active fluids collection and passive evaporation of pond fluids. Alternative 1 includes the following specific operation and maintenance elements:

- Fluid management
    - — Continue current FMS operations as described in the FMS O&M Plan (ARC,

2010).

- HLP perimeter ditch maintenance
  - — Operate and maintain HLP perimeter ditches.
- Site access controls
  - — Continue current activities to control Site access, inspect, and maintain the perimeter fence.
- Wildlife deterrents
  - — Continue current wildlife deterrent activities as described in the FMS O&M Plan.

Monitoring of the FMS system (drain-down flowrates, fluid characteristics, wildlife, etc.) would occur, and no institutional controls would be implemented. Estimated time for construction and implementation of Alternative 1 is 1 year. The time required to meet RAOs is site specific. Based upon industry standards, achieving RAOs is anticipated to require 1.5 to 3 pore volumes through the HLPs, with the timeframe to be specified during design. Estimated costs to complete this alternative are provided in Tables 12 and 13.

Alternative 1 would neither reduce any risk (human or wildlife) related to the HLP material or nor reduce any risk related to the drain-down fluids. This alternative would not meet RAO to ensure protection of groundwater or comply with the ARARs, particularly state regulations regarding mine closure.

1.11.1.3 Alternative 2 (FS Alternative 6), "Passive Evaporation and Top Capping of HLPs"

Alternative 2 provides for significant upgrades to the drain-down FMS to improve passive evaporation treatment of drain-down fluids, and the addition of HLP top deck grading and installation of 4-foot-thick top deck evaporative soil covers to minimize infiltration of precipitation into HLP materials. HLP top deck grading will create a more level surface for evaporative soil cover installation. After grading, the top deck surface of each HLP (Phase I/II, Phase III South, Phase III 4X, Phase IV Slot, and Phase IV VLT) would be covered with a 4-foot soil cover (top surface only –not side-slopes), using soil brought in from an on-site source. Spray sealant on HLP side slopes and perimeter ditch upgrades would also be part of Alternative 2.

Alternative 2 includes the following specific components:

- Fluids management
  - — Continue current FMS operations to treat the drain-down fluids via passive evaporation, as described in the FMS O&M Plan (ARC, 2010). Such

operations include moving the fluids to the evaporations ponds and moving fluids between ponds to manage volumes and optimize evaporation,

- FMS Upgrade-HLP perimeter ditch upgrade
  - — Rehabilitate, operate, monitor and maintain HLP perimeter ditches, reducing or eliminating the need for routine perimeter ditch repairs.
- Access and use restrictions – institutional and engineering controls
  - — As an institutional control, record permanent deed restrictions on OU-8 private property where mine wastes would continue to remain present. Monitor deed restrictions over time to ensure their continued presence and effectiveness. Deed restrictions would be implemented by the State in conjunction with the private landowner.
  - — As an institutional control, use restrictions on public property (managed by BLM) within this OU would be in the form of BLM's land-use management plans.
  - — The purpose of both institutional controls is to prohibit residential uses of the property and to ensure the integrity of the remedial systems (such as preventing intrusive activities through the cap and pond liners).
  - — Install, monitor and maintain no-climb fencing around the perimeter of open pond areas and clearly post, monitor and maintain warning and no trespass signs.
  - — Continue current activities to control Site access, monitor, and maintain the perimeter fence.
- Wildlife deterrents
  - — Continue current wildlife deterrent system activities as described in the FMS O&M Plan.
- HLP dust control
  - — A commercial spray sealant material would be applied to the HLPs side slopes to minimize airborne dust. The frequency of application would be based on sand content of the HLPs, local weather conditions, and the results of quarterly inspections.
- Leak detection monitoring and reporting
  - — Leak detection monitoring would be conducted using existing systems until the 4-Acre Pond liner is replaced. Following liner replacement, the new leak detection systems within the new liner would be used. Interstitial leak detection systems would be monitored (preliminarily estimated to be conducted on a quarterly basis). Periodic data reports would be prepared to document the monitoring results.
- Replacement of 4-Acre Pond liner

— Replacement of one-half (after construction of the subdividing berm) of the 4-Acre Pond liner once after five years and the other half of the pond once in the following year. Waste materials removed during liner replacement would be disposed of using an on-site repository.

- Construction of a berm across the middle of the 4-Acre Pond to split it into two cells

  — This would be done to facilitate management of the fluids in the 4-Acre Pond, to address the required solids removal and liner replacement. It would be covered with a liner (e.g. double-walled 60-mil high-density polyethylene [HDPE]) that would connect to the liner in the pond.

- Construction of a new concrete basin

  — It is assumed that the total hydraulic capacity of the new basin would be two million gallons, with a surface area of two acres. The basin would be split, using vertical concrete walls, into cells to allow flexibility for cycling among the functions of evaporation, solids removal, and standby/ready-to- be-filled mode. The outside wall would be slanted to allow equipment access for solids removal.

  — The concrete basin would be actively operated and maintained as the evaporation and solids removal facility.

- Closure of existing ponds (except the 4-Acre Pond) using an on-site soil cover (preliminarily estimated to be 2-foot thick)

  — It is assumed that minimal solids are accumulated in these other ponds. The pond liners would be removed and disposed of using an on-site disposal cell.

- Disposal of solids from evaporation ponds/basins in a new on-site repository sized to accommodate the expected solids volume

  — The repository would be constructed with a double liner (preliminarily estimated to be 60-mil HDPE) with interstitial monitoring and leak detection.

- HLP top deck grading

  — Conduct minor grading along top decks to create a more level surface for evaporative soil cover installation. Contoured top decks would not be lined.

- Installation of the evaporative soil cover

  — After grading, the top deck surface of each HLP (Phase I/II, Phase III South, Phase III 4X, Phase IV Slot, and Phase IV VLT) would be covered with a 4-foot soil cover, using soil brought in from an on-site source.

  — On-going O&M of the soil cover would occur to ensure its continued integrity.

Estimated time for construction and implementation of Alternative 2 is 2 years. The time required to meet RAOs is site specific. Based upon industry standards, achieving RAOs is anticipated to require 1.5 to 3 pore volumes through the HLPs, with the timeframe to be specified during design. Estimated costs to complete this alternative are provided in Tables 12 and 13.

The expected outcomes of Alternative 2 include reducing human and ecological exposure to HLP materials by capping the HLP tops and implementing the institutional and engineering (access) controls. Alternative 2 would also reduce drain-down fluid generation by decreasing precipitation infiltration into the HLPs, which also reduces potential releases to groundwater, although the drain-down fluid could contain higher metals concentrations as flowrates decrease. However only the top surfaces of the HLPs would be capped. The side-slopes would be sprayed using a chemical sealant which does not provide the degree of protection a complete cover would obtain. The new concrete dewatering basin and rehabilitated 4-acre evaporation pond would enable drain-down fluids to continue to be treated via evaporation and enable the evaporation pond to continue operating at full capacity. Closure of the other drain-down fluid collection/evaporation ponds would decrease the risk to wildlife. Rehabilitating the FMS system would reduce the potential for releases to groundwater. No change in land or resource use at is anticipated upon completion of the actions.

1.11.1.4 Alternative 3 (FS Alternative 8), "Passive Evaporation and Complete Capping of HLPs"

Alternative 3 provides for significant upgrades to the drain-down FMS to improve passive evaporation treatment of drain-down fluids, and the addition of major re-grading/re-shaping and capping (with a 4-foot-thick evaporative soil cover) over the entire HLP surface areas. Each of the HLPs (Phase I/II, Phase III South, Phase III 4X, Phase IV Slot, and Phase IV Slot VLT) would be entirely re-graded/re-shaped to approximately a 1.5:1 slope (rather than just grading of the top deck as in Alternative 2). The entire surface of the HLPs (top and side-slopes) would be capped with a 4-foot-thick evaporative soil cover, using soil brought in from an on-site source, along with a mechanical broadcast application of seed mixture to promote vegetative cover. Spillways would be installed atop the HLPs to collect and convey stormwater away from the HLPs and perimeter ditches will be upgraded.

Significant surface runoff is not expected off the HLPs because the remedial design concept of the evaporative soil cover is to store moisture during rainfall events and afterwards re-evaporate and transpire that moisture back to the atmosphere, keeping the HLP materials dry. However, as part of O&M, procedures would include visual observation of the HLPs during rainfall events and the ability to collect water samples of runoff should any be observed. Spillways and discharge channels have been incorporated into this alternative to minimize the potential for erosion during high rainfall events; however, under further refinement during remedial design, the necessity for these features may be re-evaluated.

Alternative 3 includes the following specific components:

- Fluids management
    - — Continue current FMS operations as described in Alternative 2.
- HLP perimeter ditch upgrade
    - — Rehabilitate, operate, and maintain HLP perimeter ditches as described in Alternative 2.
- Site access controls
    - — Continue current activities to control Site access, including inspecting and maintaining the perimeter fence.
- Access and use restrictions – institutional and engineering controls
    - — Institutional and engineering controls as described in Alternative 2.
- Wildlife deterrents
- Continue current wildlife deterrent activities as described in Alternative 2.
- Replacement of 4-Acre Pond liner
    - — Replacement of the 4-Acre Pond liner and disposal of waste materials removed during liner replacement would be as described in Alternative 2.
- Construction of a berm across the middle of the 4-Acre Pond to split it into two cells
    - — This would be done as described in Alternative 2.
- Construction of a new concrete basin
    - — Construction of a new concrete basin would be as described in Alternative 2.
- Closure of existing ponds (except the 4-Acre Pond) using a 2-foot on-site soil cover
    - — This would be done as described in Alternative 2.
- Disposal of solids from evaporation ponds/basins in a new on-site repository sized to accommodate the expected solids volume
    - — This would be done as described in Alternative 22.
- Re-grading/re-shaping entire HLPs

— The HLPs (Phase I/II, Phase III South, Phase III 4X, Phase IV Slot, and Phase IV VLT) would be entirely re-graded/re-shaped to approximately a 1.5:1 slope (rather than just grading of the top deck as in Alternative 2).

- Capping of entire HLPs

  — The entire surface of the HLPs would be capped with a 4-foot-thick evaporative soil cover, using soil brought in from an on-site source, along with a mechanical broadcast application of seed mixture to promote vegetative cover (Figure 6).

- Spillways would be installed atop the HLPs to collect and convey stormwater away from the HLPs.

Estimated time for construction and implementation of Alternative 3 is 2 years. The time required to meet RAOs is site specific. Based upon industry standards, achieving RAOs is anticipated to require 1.5 to 3 pore volumes through the HLPs, with the timeframe to be specified during design. Estimated costs to complete this alternative are provided in Tables 12 and 13.

The expected outcomes of Alternative 3 are as follows. Regrading and construction of a complete cover on the HLPs will eliminate human and ecological exposure to HLP materials. Implementing the institutional and engineering (access) controls will also control human exposure. Alternative 3 would also greatly reduce drain-down fluid generation by eliminating rainfall infiltration into the HLPs, which also reduces potential releases to groundwater by using a complete capping system, although the drain-down fluid could contain higher metals concentrations as flowrates decrease. The new concrete dewatering basin and rehabilitated 4-acre evaporation pond would enable drain-down fluids to continue to be treated via evaporation and enable the evaporation pond to continue operating at full capacity. Closure of the other drain-down fluid collection/evaporation ponds would decrease the risk to wildlife. Rehabilitating the FMS system would reduce the potential for releases to groundwater. No change in land or resource use at is anticipated upon completion of the actions.

1.11.1.5 Alternative 4 (FS Alternative 6a/8a), "Modified Evaporation, Complete Capping of HLPs, Pond Conversion to E-cells, and Stormwater Management"

NDEP originally identified Alternative 4 in the FFS (SRK Consulting, Inc., 2015) as an alternative approach for closure of the HLPs and to address FMS operation and ultimately closure of the FMS at the Arimetco facilities. EPA and BLM included this alternative in the FS (CB&I, 2016a) for the HLPs and FMS for evaluation (as FS Alternative 6a/8a).

Alternative 4 combines elements from Alternatives 2 and 3. This remedial alternative includes placement of a minimum two feet of cover depth over the entire HLP surface areas. The final thickness of the cover will be determined during the remedial design. The conceptual side slope grading plans were developed in the FFS (SRK Consulting, Inc., 2015) using spent ore for balanced cut-to-fill where possible, and re-graded to a slope of 2.5H:1V or shallower. This approach is consistent with current practices in Nevada for HLP closures approved through the NDEP Bureau of Mining Regulation and Reclamation. Passive evaporative treatment would be performed in the existing evaporative pond system. Under Alternative 4, solid dewatering/ management for the solids from passive evaporative treatment would be implemented by a program of removal and reprocessing of the evaporative solids or by in-place closure of the evaporative solids in the 4-Acre Pond. New stormwater sedimentation basins and their interconnected ditch system are also included under this alternative. This alternative also includes an interim stormwater management plan and conversion of existing evaporative ponds to E-cells when the capacity needs decrease (Figure 7).

Alternative 4 includes the following specific elements:

- Fluids management
    - Continue current FMS operations as described in Alternative 2. with the following upgrades as discussed in more detail below: 1) gravel-filled drains constructed within the existing geomembrane-lined drain-down collection channels, 2) construction of stormwater sediment basins, and 3) interim stormwater management planning.
- HLP perimeter ditch upgrade
    - Rehabilitate, operate, and maintain HLP perimeter ditches as described in Alternative 2.
- Access restrictions and engineering controls
    - Institutional and engineering controls as described in Alternative 2.
- Wildlife deterrents
    - Continue current wildlife deterrent activities as described in the Alternative 2.
- Leak detection monitoring and reporting
    - Leak detection monitoring will be conducted using existing systems until the E-cells are constructed, or the ponds otherwise closed. Following construction of the E-cells, the new leak detection systems within the new liner systems will be used. Interstitial leak detection systems will be monitored (preliminarily estimated to be conducted on a quarterly basis). Periodic data reports will be prepared to document the monitoring results.

- Re-grading/re-shaping entire HLPs
    - — The HLPs (Phase I/II, Phase III South, Phase III 4X, Phase IV Slot, and Phase IV VLT) will be entirely re-graded/re-shaped. Prior to side slope re-grading, gravel-filled drains will be constructed within the existing geomembrane-lined drain-down collection channels at each of the HLPs to facilitate collection of heap drain-down during and after over-dumping. Conceptual side slope grading plans were developed in the FFS (SRK Consulting, Inc., 2015) using spent ore for balanced cut-to-fill where possible, and re-graded to a slope of 2.5H:1V or shallower. Top surface re-grading currently assumes final leach pad surfaces will be re-graded to a minimum final grade of three percent to prevent ponding of surface water.

- Cover placement
    - — This alternative closure plan includes placement of a minimum two feet of evaporative cover depth over the entire HLP surface areas along with a mechanical broadcast application of seed mixture to promote vegetative cover. This minimum thickness was selected because it has been found to be effective and to meet the performance standards provided in the state regulations at similar sites in Nevada. The actual thickness will be determined during the remedial design phase. HLPs must be stabilized in accordance with NAC 445A.430, "Stabilization of Spent Ore" which provides both performance standards for effluent discharged from spent ore and requirements to meet antidegradation policy/protection for waters of the state. These requirements are consistent with the CERCLA criteria for reducing toxicity, mobility, or volume of contaminants from the HLPs. During the remedial design, the properties of the cover material such as soil type, permeability, and compaction as well as the contaminant characteristics will be reviewed to determine the appropriate thickness to address the mobility of the contaminants. Unsaturated cover infiltration modeling may be performed, or other cover assessment methods used, to determine the most appropriate final cover thickness based on available soil borrow materials, while minimizing infiltration and drain-down through the HLPs. Suitable capping material exists on site in sufficient quantities to support cover placement on the HLP.

- Construction of stormwater sedimentation basins
    - — These new features (preliminarily estimated to consist of 4 units) will be designed to contain a 100-year, 24-hour storm event.

- Interim stormwater management planning
    - — Development of an interim stormwater management plan for use until such time as closure planning for the rest of the Anaconda Copper Mine is sufficiently advanced to facilitate development of a comprehensive plan for the Site. The OU-8 stormwater plan will be designed and implemented as a stand-

alone system with connection points designed and built but not activated until adjacent areas stormwater systems are designed and constructed.

— Because this alternative was added to the FS based on the 2015 FFS, a new stormwater management system was included in the alternative while upgrades for Alternatives 2 and 3 from the original FS provide only upgrades to the existing ditch system.

- Conversion of existing ponds to E-cells, as needed

  — Existing FMS will be maintained until the drain-down flows have reduced sufficiently to allow for passive evaporation in all or a part of the current FMS. At the appropriate time, some or all of the existing ponds will be converted to soil-filled double-lined E-cells with sufficient volume and surface area to store and eliminate through passive evaporation the combined precipitation and seepage inventory generated on an annual basis from the measured post-closure seepage flow rates.

  — A detailed water balance should be prepared for each pond using the monitoring record to predict evaporation cell performance and maintain fluid levels in the pond within the soil backfill. The E-Cells should be of sufficient size to temporarily manage 100-year, 24-hour storm precipitation (3.01 inches) falling within the cell perimeter and provide at least two feet of freeboard to eliminate overtopping risks.

  — Construction tasks required to convert the ponds will include, at a minimum:

    1. Removal/evaporation of existing pond inventory;
    2. Removal of pond sediments;
    3. Inspect and repair existing liner;
    4. Construct gravel-filled sump in lowest corner of the pond, to include vertical HDPE monitoring riser pipe;
    5. Place geonet and primary 80 mil single-sided textured HDPE liner (texture up) or 80 mill Agru Drain Liner to pond base and sideslopes;
    6. Backfill pond with 3 feet of nominally-compacted relatively fine-grained alluvium;
    7. Excavated to within 6 inches of liner a network of seepage distribution trenches;
    8. Line trench system with 8 oz/sy non-woven, needle-punched geomembrane;
    9. Place 4-inch perforated corrugated polyethylene pipe (ADS N-12 or approved equivalent) in base of trenches and connect to form

subsurface seepage distribution system;

10. Backfill trenches with clean drain rock to within 6 inches of backfill surface and overlap geotextile on top;
11. Backfill remainder of trench with 6 inches of relatively fine-grained alluvium;
12. Place additional 6 inches of relatively fine-grained alluvium over backfilled pond surface;
13. During pond backfilling, install vertical riser piezometer within pond backfill to monitor saturations levels in backfill; and
14. Install flow measurement point prior to discharge point into pond.

—

- Disposal of solids from evaporation ponds/basins

  — Materials will be removed and reprocessed or closed in-place.

- 4-Acre Pond closure

  — The existing 4-Acre Pond will be closed in-place either by removal and reprocessing of the pond inventory or by encapsulation. Encapsulation will require that the pond contents be physically stabilized via the addition of cement or other stabilizing agent or through mixing with suitable borrow material to form a firm foundation sufficient for geomembrane liner installation and placement of a soil over-liner layer with over-liner infiltration drains. Additional characterization would be required prior to selecting the preferred remedial design for closure of the 4-Acre Pond.

  — NOTE: Many or most of the remedial design details are preliminary, and are potentially subject to change based on design phase discussions and engineering practices, and preliminary design elements will be approved by the agencies after vetting with key stakeholders.

Estimated time for construction and implementation of Alternative 3 is 2 years. Estimated costs to complete this alternative are provided in Tables 12 and 13.

The expected outcomes of Alternative 4 include eliminating human and ecological exposure to HLP materials by regrading and a complete cap on the HLPs, placing a fine-grained alluvium over the E-cell backfilled pond surface, and implementing the institutional and engineering (access) controls. Alternative 4 would also greatly reduce drain-down fluid generation by eliminating rainfall infiltration into the HLPs by providing a cover on both the top and side slopes. The complete cover also reduces potential releases to groundwater, although the drain-down fluid could contain higher metals concentrations as flowrates decrease. Eventual conversion of the evaporation ponds to e-cells would enable the lower volumes of drain-down fluids produced to continue to be treated via passive evaporation but without the risk to wildlife posed by open water evaporation ponds. Rehabilitating the FMS system would reduce the potential for releases to groundwater. No change in land or resource use at is anticipated upon completion of the actions.

1.11.2 Common Elements and Distinguishing Features of Each Alternative

Since no action is taken under Alternative 0, there are no components to this alternative and it is not included for discussion in this section. The four remaining alternatives, presented in the Proposed Plan (EPA, 2016a), address the protection of human health and ecological receptors from direct contact exposure to pollutants or contaminants present at levels of concern in drain-down fluids and HLP materials. The alternatives also address the protection of groundwater from releases or threats of release of pollutants or contaminants present at levels of concern in drain-down fluids. Alternatives 2, 3 and 4 have identified common conceptual remedial approaches. These remedial approaches include:

- Implementation of additional Site access controls, land-use controls and wildlife deterrents
- Containment of HLP materials (a complete cover under Alternative 2 and a complete cover under Alternatives 3 and 4)
- Capture of drain-down fluids and treatment by evaporation
- Management and disposal of treatment residuals as needed
- Rehabilitation of HLP perimeter ditches

These remedial approaches involve continuing the following current activities:

- Continuation of existing FMS operations
- Site access controls
- Wildlife deterrents

HLP covers are included under Alternatives 2, 3, and 4. Alternative 2 includes the installation of a top deck cover and Alternatives 3 and 4 include full covers including side slopes. Alternatives 2 and 3 have 4-foot thick covers and Alternative 4 has a minimum 2-foot thick cover. Alternative 3 would involve re-grading the HLP side slopes to a slope of 1.5H:1V, whereas Alternative 4 would have a 2.5H:1V slope.

Continued drain-down fluid management and treatment is included in Alternatives 2, 3 and 4, and all three alternatives include upgrades to the drain-down fluid collection system. Alternatives 2 and 3 both have the same upgrades to the existing 4-Acre Pond and the construction of a 2-acre concrete basin. Alternative 4 does not have those upgrades or the concrete basin, instead relying on the other existing evaporation ponds for passive evaporative treatment, and eventually converting them to e-cells. Disposal of solids is handled in Alternatives 2 and 3 with disposal at a new on-site repository, whereas Alternative 4 handles the solids by removal and reprocessing or in-place closure in the 4-Acre Pond.

Alternative 4 is the only alternative to include a stormwater management feature, which involves both stormwater management planning as well as constructing a system to collect and route stormwater from the OU to new stormwater sedimentation basins.

1.12 Comparative Analysis of Alternatives

In accordance with CERCLA and NCP requirements, the comparative analysis for OU-8 was conducted to evaluate the relative performance of the alternatives retained for detailed evaluation against the following nine remedial alternative evaluation criteria:

1. Overall protection of human health and the environment
2. Compliance with ARARs
3. Long-term effectiveness and permanence
4. Reduction of toxicity, mobility or volume through treatment
5. Short-term effectiveness
6. Implementability
7. Cost
8. State Acceptance
9. Community acceptance

The purpose of this comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another and to particular Site conditions to identify the key tradeoffs for decision-makers.

State acceptance and community acceptance were evaluated after public comment on the FS (CB&I, 2016a) and the Proposed Plan (EPA, 2016a). The State of Nevada has concurred with the remedy selected for OU-8 in this ROD. Public Acceptance is addressed in Section 3.0.

The NCP (40 Code of Federal Regulations Part 300.430(e)(9)(iii)) categorizes the nine remedy evaluation criteria into three groups as follows:

- Threshold criteria (No. 1 and 2, above)
  - — Threshold criteria are requirements that each alternative must meet to be eligible for selection as the Preferred Alternative and include overall protection

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of human health and the environment and compliance with ARARs (unless a waiver is obtained).

- Primary balancing criteria (No. 3 through 7, above)
  - — Primary balancing criteria are used to weigh effectiveness and cost tradeoffs among alternatives. The primary balancing criteria include long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. The primary balancing criteria represent the main technical criteria upon which the alternatives evaluation is based.
- Modifying criteria (No. 8 and 9, above):
  - — Modifying criteria include state acceptance and community acceptance, and may be used to modify aspects of the Preferred Alternative when preparing this ROD.

The comparative analysis of the alternatives is presented in the following subsections for the five alternatives presented in this ROD. The discussion is presented to address the most favorable alternative first, as based on the comparative analysis, and conclude with the least favorable alternative for each CERCLA evaluation criterion. Table 12 summarizes the detailed analysis of Alternatives 0, 1, 2, 3, and 4 (or FS Alternatives 1, 2, 6a, 8a, and 6a/8a) against CERCLA criteria and the comparative analysis of the remedial alternatives against each other.

1.12.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated; reduced; or controlled through treatment, engineering controls, and/or institutional controls.

Alternative 0 is considered not protective of human health and the environment. With this alternative, no action would be taken at Arimetco OU-8, and current activities such as the FMS operations and maintenance would cease. The potential for short-term and long-term human health risks from exposure to contaminated drain-down fluids and heap materials would increase dramatically because existing site access controls and FMS operations would not be maintained. The potential for ecological risk associated with exposure to drain-down fluids would increase because there would be no wildlife deterrents. Additionally, no action would be taken to reduce the risk of groundwater contamination through potential releases of drain-down fluids or to control future human and ecological exposure to contamination present in soil (heap materials), groundwater, or surface water (drain-down fluids in ponds).

Alternative 1 is considered not protective of human health and the environment. Alternative 1 provides for the continuation of the current cleanup activities at OU-8 facilities. Current actions include continued implementation of FMS operations, Site access controls, and wildlife deterrents. However, Alternative 1 does not include any additional efforts to contain or prevent exposure to HLP materials, does not reduce infiltration of precipitation into HLP materials to reduce the formation of drain-down fluids, or make any improvements to the FMS to enhance passive evaporative treatment of drain-down fluids. The threat to wildlife from open fluid surfaces would continue to be solely mitigated by wildlife deterrents, which are not completely effective. Any existing releases to groundwater would continue and would likely increase over time without pond liner replacement, significant FMS system improvements, or HLP covers.

Alternative 2 is considered protective of human health and the environment. The degree of protectiveness for Alternative 2 is considered to be high, although not as high as Alternative 3 or Alternative 4. The 4-foot-thick top deck evaporative soil covers, combined with the use of spray sealants (as needed) on the side slopes, would provide containment of HLP materials and reduce but not eliminate the risk of direct contact with COCs in HLP materials or wind blow dust from the HLPs. The 4-foot-thick evaporative soil top cover would significantly reduce the infiltration of precipitation into the HLPs and reduce the generation of drain-down fluids. Alternative 2 includes the FMS improvements that are incorporated into Alternative 3 but not as many improvements as Alternative 4. Alternative 2 includes the rehabilitation of the 4-Acre Pond and construction of a concrete basin, which would enable continued treatment of drain-down fluids at full capacity via evaporation, although the open surface fluids would continue to present a hazard to wildlife that requires ongoing mitigation via the wildlife deterrents. Alternative 2 includes the other control measures (e.g., Site access controls, wildlife deterrents, and engineering controls) included in each of the other alternatives presented in the Proposed Plan (EPA, 2016a) (Alternatives 1, 3, and 4).

Alternative 3 is considered protective of human health and the environment. The degree of protectiveness for Alternative 3 is considered to be higher than for Alternatives 1 and 2 because the 4-foot-thick evaporative soil cover would be applied to the entire surface area of the HLPs, thereby providing containment of HLP materials and eliminating the risk of direct contact with COCs in HLP materials or wind blow dust from the HLPs. The 4-foot-thick cover would also eliminate the infiltration of precipitation into the HLPs and minimize the generation of drain-down fluids discharging from the HLPs, minimizing potential impact to groundwater. Alternative 3 includes the FMS improvements that are incorporated into Alternative 2. Alternative 3 includes the other control measures (e.g., Site access controls, wildlife deterrents, and engineering controls) included in each of the other alternatives presented in the Proposed Plan (EPA, 2016a) (Alternatives 1, 2, and 4). Similar to Alternative 2, Alternative 3 includes the rehabilitation of the 4-Acre Pond and construction of a concrete basin, which would enable continued treatment of drain-down fluids at full capacity via evaporation, although the open surface fluids would continue to present a hazard to wildlife that requires ongoing mitigation via the wildlife deterrents.

Alternative 4 is considered protective of human health and the environment. The degree of protectiveness for Alternative 4 is similar to Alternative 3, and is considerably higher than Alternatives 1 and 2 because the minimum 2-foot-thick evaporative soil cover will be applied to the entire surface area of the HLPs, thereby providing containment of HLP materials and eliminating the risk of direct contact with COCs in HLP materials or wind blow dust from the HLPs. Under Alternative 3, the cover is set as a 4-foot thickness. The cover under Alternative 4 is a minimum 2-foot thickness. The actual thickness will be determined during the remedial design and will be optimized to control infiltration and migration of contaminants as discussed in Section 2.4.1.4. The minimum 2-foot-thick cover included in Alternative 4 will be designed to eliminate the infiltration of precipitation into the HLPs, the same as Alternative 2. During the remedial design, the properties of the cap cover material such as soil type, permeability, and compaction as well as the contaminant characteristics will be reviewed to determine the appropriate thickness to address the mobility of the contaminants. The covers in Alternative 4 will also be designed to manage stormwater runoff from the HLPs. Alternative 4 includes significantly more upgrades to the FMS than Alternative 3; these upgrades reduce potential leakage of any continuing drain-down fluids and minimizes potential impacts to groundwater. Alternative 4 includes the other control measures (e.g., Site access controls, wildlife deterrents, and engineering controls) included in each of the other alternatives presented in the Proposed Plan (EPA, 2016a) (Alternatives 1, 2, and 4). This alternative also includes conversion of existing FMS ponds to E-cells and closure of the 4-Acre Pond, which would eventually eliminate the hazard to wildlife posed by open surface fluids.

1.12.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, 42 United States Code Section 9621(d) requires that remedial actions at CERCLA sites attain (or justify the waiver of) any federal or state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. Federal ARARs may include requirements under any federal environmental laws. State ARARs include promulgated, enforceable environmental or facility-siting laws of general application that are more stringent or broader in scope than federal requirements.

An ARAR may be either “applicable,” or “relevant and appropriate,” but not both. If there is no specific federal or state ARAR for a particular chemical or remedial action, or if the existing ARARs are not considered sufficiently protective, then other guidance or criteria to be considered (TBCs) may be identified and used to ensure the protection of public health and the environment. The NCP, 40 C.F.R. Part 300, defines “applicable,” “relevant and appropriate,” and “to be considered” as follows:

- **Applicable** requirements are those cleanup standards; standards of control; or other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility-siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstances found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable.

- **Relevant and appropriate** requirements are those cleanup standards; standards of control; and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility-siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and that are more stringent than federal requirements may be relevant and appropriate.

- **TBCs** consist of advisories, criteria, or guidance that EPA, other federal agencies, or states developed that may be useful in developing CERCLA remedies. The TBC values and guidelines may be used as EPA deems appropriate. Once a TBC is adopted, it becomes an enforceable requirement.

ARARs are identified on a site-specific basis from information about the chemicals at the Site, the remedial actions contemplated, the physical characteristics of the Site, and other appropriate factors. ARARs include only substantive requirements, not administrative requirements, and pertain only to on-site activities. Section 121(e) of CERCLA, 42 U.S.C. § 9621(e), states that no federal, state, or local permit is required for remedial actions conducted entirely on-site. Off-site activities, however, must comply with applicable federal, state, and local laws, including both substantive and administrative requirements that are in effect when the activity takes place. There are three general categories of ARARs:

- Chemical specific ARARs are health- or risk-based concentration limits, numerical values, or methodologies for various environmental media (i.e., groundwater, surface water, air, and soil) that are established for a specific chemical that may be present in a specific media at the Site, or that may be discharged to the Site during remedial activities. These ARARs set limits on concentrations of specific hazardous substances, pollutants, and contaminants in the environment. Examples of this type of ARAR include state and federal drinking water standards.

- Location specific ARARs set restrictions on certain types of activities based on Site characteristics. Federal and state location specific ARARs are restrictions placed on the concentration of a contaminant or the activities to be conducted because they are in a specific location. Examples of special locations possibly requiring ARARs may include flood plains, wetlands, historic places, and sensitive ecosystems or habitats.

- Action specific ARARs are technology or activity based requirements that are triggered by the specific type of remedial activities selected. Examples of this type of ARAR are Resource Conservation and Recovery Act (RCRA) regulations for waste treatment, storage, or disposal.

Compliance with ARARs addresses whether a remedy will meet ARARs of other federal and state environmental statutes or provides a basis for invoking a waiver.

Alternatives 3 and 4 are the most likely of all the alternatives to fully comply with ARARs. These alternatives more closely approach the mine closure practices required under NAC445A.350-447, and NAC519A.010-345. It is expected that implementing the proposed significant upgrades to the drain-down FMS and installing the evaporative covers on the entire surface of the HLPs, as specified in Alternatives 3 and 4, provide a reasonable chance of meeting state ARARs for groundwater protection. The new FMS facilities will meet State of Nevada ARARs. However, full compliance with ARARs will depend on the condition of the existing HLP liners and portions of the existing drain-down FMS that will not be improved. The solids generated by fluids evaporation would be disposed of in an on-site disposal cell (Alternative 3) or in-place in the 4-Acre Pond (Alternative 4) in an ARAR-compliant manner. Under Alternatives 3 and 4, other FMS ponds would also be closed in compliance with ARARs.

The degree of compliance with ARARs of Alternatives 2, 3, and 4 are similar. However, Alternative 2 is considered to be less likely to comply with ARARs because the HLPs would only be partially covered (4-foot-thick evaporative soil covers on the top decks only with spray sealants on the side slopes). It is anticipated that Alternative 2 may comply with State of Nevada ARARs for mine closure, but this alternative approach is not consistent with recently completed mine closures approved by the State of Nevada that have required complete HLP covers. Under Alternatives 2, 3, and 4, the upgrades to the FMS components, the solids disposal, and closure of the other FMS ponds would also be compliant with ARARs.

Alternative 0 and 1 would not comply with ARARs. This alternative is not expected to comply with State of Nevada mine unit closure ARARs for HLPs and is not expected to comply with groundwater protection ARARs (leakage from HLP liners and the existing infrastructure of the drain-down FMS is expected to impact groundwater quality).

1.12.3 Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain following remediation and the adequacy and reliability of controls.

Alternative 4 provides the most long-term effectiveness and permanence compared to the other alternatives because it alone includes eventual conversion of existing ponds to E-cells, thus eliminating surface fluid ponds that threaten wildlife. Alternative 4 as well as 3 provides greater long-term effectiveness and permanence compared to Alternative 2 because these alternatives would provide substantial additional risk reduction (related to exposure to HLP materials and generation of drain-down fluids) by grading the HLPs and installing evaporative soil covers over the entire surface of the HLPs. Although the Alternative 4 cover is a minimum of 2 feet thick compared to 4 feet thick in Alternative 3, its thickness is consistent with the current mine closure practices for HLPs in the State of Nevada and is considered to be effective and permanent. For the Alternative 4, 3 and 2 covers, it is expected that ongoing releases from the HLPs to groundwater, though significantly reduced, remain possible depending on the existing conditions of the HLP liners. Alternative 4 also includes stormwater planning and management features, providing additional long-term effectiveness and permanence. Alternatives 4, 3 and 2 all include substantial improvements to the FMS, disposal of solids, Site access controls, wildlife deterrents and land-use controls (LUCs), which contribute to long-term effectiveness.

Alternative 3 is expected to effectively reduce the long-term risks to human health and the environment. Compared to Alternative 4, the 4-foot-thick evaporative soil covers of Alternative 3 would provide a greater certainty of long-term effectiveness than the minimum 2-foot cover of Alternative 4. As in Alternative 2 the use of a new concrete basin for evaporation and solids dewatering will enhance and simplify evaporation and dewatering operations, and construction of the berm across the 4-Acre Pond will also facilitate management of the drain-down fluids and simplify the required solids removal and pond liner replacement. These actions improve the long-term effectiveness of the FMS.

Alternative 2 provides a relatively high degree of long-term effectiveness and permanence, although less than Alternatives 3 and 4 because under Alternative 2, the evaporative soil cover would only be placed on the top decks of the HLPs and spray sealants would be used on the side slopes, as needed. Alternative 2 includes the same concrete basin and 4-Acre Pond rehabilitation as Alternative 3 and the same Site access controls, wildlife deterrents and LUCs as the other alternatives.

The long-term effectiveness and permanence of Alternative 1 is limited in that current risks would remain and future risks to human health and the environment, including discharges to groundwater, would likely increase as no actions would be taken to improve drain-down fluids management and the HLPs would not be actively maintained.

Alternative 0 does not provide long-term effectiveness and permanence because current operations would cease under Alternative 0, near-term risks would be greater under this alternative than under current conditions. Future risks to human health and the environment would also be significantly greater than current levels.

1.12.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies employed on source materials that may be included as part of a remedy.

For Alternative 0, there is no reduction of toxicity, mobility, or volume because no action would be taken. Under Alternatives 1, 2, 3 and 4, passive evaporation treatment of drain-down fluids would continue, reducing contaminant mobility and the total volume of contaminated HLP fluids; however, the drain-down fluids have low pH and contain high concentrations of metals, inorganics, and radionuclides. Additionally, the mobility of contaminated drain-down fluid would be decreased through containment in the FMS ponds in all the alternatives.

Alternatives 2, 3, and 4 provide a greater reduction in mobility than Alternative 1 because the pond liners would be replaced and, therefore, leakage to groundwater would be reduced or eliminated. Under Alternatives 2, 3, and 4 management of precipitation by the evaporative soil covers would reduce the volume of contaminated drain-down fluid generated. Alternative 4 also includes conversion of ponds to E-cells providing additional reduction in mobility and volume of contaminated fluids.

1.12.5 Short-term Effectiveness

Short-term effectiveness addresses the timeframe needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction and operation of the remedy until cleanup levels are achieved.

There would be essentially no short-term impacts for Alternatives 0 and 1 because this alternative does not include any new construction activities.

Alternative 2 would present the least short-term impacts. Earthwork activities associated with Alternative 2 would be extensive, although not nearly as extensive as Alternatives 3 and 4 because of the much smaller area to be re-graded and covered (top decks only). The most significant potential community impact would be dust generation during construction. Impacts from dust during construction can usually be mitigated through use of aggressive dust control measures. However, given the frequent occurrence of wind events at the Site, dust control will require careful consideration and planning. As with the other alternatives, workers handling contaminated materials during construction must be appropriately trained and equipped with personal protective equipment.

The extensive earthmoving activities for the Alternatives 4 covers creates more potential short-term impacts to human health and the environment during construction than Alternative 2. However, because of the reduced thickness of the cover and change in side slopes compared to Alternative 3, the volume of material to be moved under Alternative 4 is substantially reduced and the potential short-term impacts substantially less.

Alternative 3 involves the most earthmoving activities and thus presents the greatest potential short-term impacts of all the alternatives.

1.12.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from remedial design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Alternative 0 is easy to implement as no actions are taken.

Alternative 1 is readily implementable because it already is being implemented at OU-8.

Implementation of Alternative 2 could be challenging because of the magnitude of the required on-site construction efforts and materials handling activities. However, implementation of Alternatives 4 and 3 would be the most challenging because of the much greater volumes of material needed to be re-graded and transported for installation of the evaporative soil covers over the entire HLP surface areas. However, the equipment, materials, and labor required for this construction are expected to be readily available, and the technologies required are well understood.

Implementation of LUCs included in Alternatives 2, 3, and 4 will require coordination with EPA, state, BLM, and property owners.

1.12.7 Cost

Cost estimates were prepared consistent with EPA guidance which states that expected accuracy range of the cost estimate is –30 to +50 percent for detailed analysis of alternatives. Cost estimates developed during the detailed analysis phase are used to compare alternatives and support remedy selection. There are no costs associated with Alternative 0 because no actions are taken The cost for Alternative 1 ($2.1 million 30-year net present value [NPV]) is the lowest as compared to the remaining three alternatives, as it maintains current FMS operations, Site access controls, and wildlife deterrents and no further action is taken to address OU-8 pollutant and contaminant sources.

Alternative 2 ($29.7 million 30-year NPV) has a higher cost than Alternative 1, as it requires extensive earth moving activities and labor requirements in addition to the drain-down FMS upgrades. Alternative 4 ($36.1 million 30-year NPV) is higher in cost than Alternative 2 but lower in cost than Alternative 3 ($58.2 million 30-year NPV). Both Alternatives 4 and 3 have extensive earth moving activities and labor requirements. Table 13 provides the cost summary for each alternative.

1.12.8 State Acceptance

This criterion considers whether the State agrees with the analyses and recommendations, as described in the RI/FS and Proposed Plan.

The State of Nevada concurs with the Preferred Alternative.

1.12.9 Community Acceptance

This criterion considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

The community includes residents of the Mason Valley and all the various stakeholders (elected city, county, state and federal representatives, tribes, community groups, environmental groups, local and state agencies, etc).

The most common subject addressed by the public comments was the design and construction of the HLP covers. Many of the public comments pertained to technical issues regarding the design and construction of the HLP covers. Some commenters advocated for a thicker layer of cover materials than indicated in the Proposed Plan. Other commenters advocated for a flexible or phased construction implementation approach. Several comments expressed the desire for the remedial actions to be implemented in coordination with actions at other Site OUs.

There were a significant number of comments that challenged specific wording, descriptions, or conclusions expressed in the Proposed Plan to describe the Site history, background and studies that were addressed in the Response to Comments.

There were a few comments that addressed the FMS. One commenter disagreed with the proposed evaporation pond and e-cell fluid management strategy. Several commenters expressed concerns about the potential interim use of enhanced evaporation that was mentioned in the Proposed Plan. One commenter advocated for expanding use of enhanced evaporation and deferring the HLP closures.

Miscellaneous other comments addressed several other topics. Several commenters expressed the desire for Sitewide stormwater control. Some commenters asked about the political climate as pertains to the availability of federal funding. Finally, some comments were received regarding the NPL listing and discussions about potential NPL deferral.

These concerns and the other comments provided to EPA during the public comment period are addressed in Part 3 of this ROD, Responsiveness Summary.

1.13 Principal Threat Wastes

Federal law establishes an expectation for the use of treatment to address the principal threats posed by a site wherever practicable. Principal threat wastes are those source materials at a site that are considered to be highly toxic or highly mobile and that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. These types of wastes include liquid sources, surface or subsurface soil containing high concentrations of chemicals, or buried drummed non-liquid wastes containing significant concentrations of highly toxic materials.

The Selected Remedy satisfies the statutory preference for treatment as a principal element of the remedy. The contaminated drain-down fluids from the HLPs are considered to be PTWs due their high levels of contaminants and their related toxicity to human health and environmental receptors. Under the alternatives, these drain-down fluids will be collected and managed in the upgraded FMS, treated by passive evaporation and the solids from the evaporation ponds/basins will be managed by either reprocessing and removal, in-place closure in the 4-Acre Pond, or disposal in an on-site repository. The HLP materials are not considered to be PTWs due to the high volumes of low-grade ores with low concentrations of metals and radionuclides. It would not be practicable to treat the HLP materials to the extent necessary to meet statutory preference for treatment of wastes to reduce their volumes or toxicity or permanently reduce mobility of contaminants. However, the alternative will reduce mobility of the HLP pollutants and contaminants by capping of the HLPs to contain the materials in-place, prevent direct contact, limit infiltration of meteoric water and reduce or eliminate the generation of acidic, metal-bearing drain-down fluids.

1.14 Description of the Selected Remedy

This ROD selects Proposed Plan (EPA, 2016a) Alternative 4 (FS Alternative 6a/8a), “Modified Evaporation, Complete Capping of HLPs, Pond Conversion to E-cells, and Stormwater Management,” as the remedial action for the pollutant and contaminant sources associated with the five HLPs and the drain-down FMS that are components of OU-8.

The Selected Remedy includes the following:

1. Evaporative covers
2. Upgrades to drain-down FMS
3. Passive evaporation treatment of drain-down fluids
4. Fluids management with wildlife deterrents
5. Conversion of evaporation ponds to E-cells
6. Closure of the 4-Acre Pond
7. Site access and land-use controls
8. Stormwater management system

1. HLP Covers

The HLPs (Phase I/II, Phase III South, Phase III 4X, Phase IV Slot, and Phase IV VLT) will be entirely re-graded/re-shaped, both top surfaces and side slopes, and covered with a minimum 2-foot-thick cover over the entire re-graded pad. The final thickness of the cover will be determined during the remedial design. Suitable cover material exists on site in sufficient quantities to support cover placement on the HLP. The covers will also include the installation of stormwater control measures. Prior to side slope re-grading, gravel-filled drains will be constructed within the existing geomembrane-lined drain-down collection channels at each of the HLPs to facilitate collection of heap drain-down during and after over-dumping. Conceptual side slope grading plans have been developed in the FFS (SRK Consulting, Inc., 2015) using spent ore for balanced cut-to-fill where possible, and re-graded to a slope of 2.5H:1V or shallower. Top surface re-grading currently assumes final leach pad surfaces will be re-graded to a minimum final grade of 3 percent to prevent ponding of surface water.

2. Upgrades to Drain-Down FMS collection and transfer components

Portions of the FMS collection and transfer system will be upgraded, rehabilitated or closed as needed. The system will be inspected during remedial design and components requiring such actions will be identified. FMS system collection and transfer components will be monitored, inspected and repaired as needed.

3. Passive Evaporation Treatment of Drain-Down Fluids

The HLP drain-down fluids will be treated with passive evaporation in the existing FMS. The existing system includes drain-down perimeter ditches that capture drain-down fluids from the HLPs, pipes and pumps that transfer the fluids to or between evaporation ponds and sediment ponds. Current FMS operations will be continued as described in FMS O&M Plan (ARC, 2010). Leak detection monitoring will be conducted using the existing system.

4. Fluids management with wildlife deterrents

Current wildlife deterrent activities will be continued as described in FMS O&M Plan (ARC, 2010).

5. Conversion of evaporation ponds to E-cells

The existing FMS will be operated and maintained until the HLP drain-down flows are sufficiently low to allow for passive evaporation in E-cells in all or a part of the FMS. At the appropriate time, some or all of the existing ponds will be converted to soil-filled double-lined E-cells with sufficient volume and surface area to store and eliminate through passive evaporation the combined precipitation and seepage inventory generated on an annual basis. Following construction of the E-cells, the new leak detection systems within the new liner systems will be used. Interstitial leak detection systems will be monitored regularly. Regular data reports will be prepared to document the monitoring results.

6. Closure of the 4-Acre Pond

In the future, when no longer needed, the existing 4-Acre Pond will be closed in-place either by removal and reprocessing of the pond inventory or by encapsulation. Encapsulation will require the pond contents be physically stabilized via the addition of cement or other stabilizing agent or through mixing with suitable borrow material to form a firm foundation sufficient for geomembrane liner installation and placement of a soil over-liner layer with over-liner infiltration drains. Additional characterization is required prior to preparation of the detailed design for closure of the 4-Acre Pond.

7. Site Access and Land-Use Controls

Current activities to control Site access will be continued, including monitoring and maintaining the perimeter fence. No-climb fencing around the perimeter of the open pond areas will be installed, monitored and maintained. Warning and no trespass signs will be clearly posted, monitored and maintained.

As an institutional control, permanent deed restrictions will be recorded on OU-8 private property where mine wastes would continue to remain present. Deed restrictions will be monitored over time to ensure their continued presence and effectiveness. Deed restrictions would be implemented by the State in conjunction with the private landowner. The purpose of this institutional control is to prohibit residential uses of the property and to ensure the integrity of the remedial systems. No actions that would negatively impact the integrity of the remedial systems would be allowed unless a plan to ensure protection of human health and the environment is approved in advance by the agencies.

As an institutional control, use restrictions will be placed on the public property (managed by BLM) within this OU in the form of BLM's land-use management plans. The purpose of this institutional control is to prohibit residential uses of the property and to ensure the integrity of the remedial systems. No actions that would negatively impact the integrity of the remedial systems would be allowed unless a plan to ensure protection of human health and the environment is approved in advance by the agencies.

8. Stormwater Management System

An interim stormwater management plan will be developed for use until closure planning for the rest of the Site is sufficiently advanced to facilitate development of a comprehensive plan. The stormwater management system will be designed and constructed to serve as a stand-alone stormwater system that will address the 100-year, 24-hour storm event at OU-8, without allowing runoff to other portions of the site. The stormwater basins will also be designed and constructed with the long-term objective of connecting to and complementing site-wide stormwater management features in adjacent areas of the site. Site-wide stormwater connections are part of the preferred alternative; connections to the OU-8 stormwater system will be completed as adjacent areas undergo remedial action.

1.15 Summary of the Rationale for the Selected Remedy

Alternative 4, "Modified Evaporation, Complete Capping of HLPs, Pond Conversion to E-cells and Stormwater Management," is the Selected Remedy to address the potential human health and ecological risk from the heap leach materials and drain-down fluids and prevent migration to groundwater.

Alternative 4 is selected because it will meet RAOs and achieve substantial risk reduction by both (1) treating the source materials constituting principal threats at the Site and (2) providing safe management of remaining material. This combination reduces risk sooner than the other alternatives, costs less than Alternative 3, and is comparable in cost to Alternative 2. The agencies agree that a maximum degree of protectiveness occurs with Alternative 4 actions, although, as in Alternatives 2 and 3, short-term exposure risks are increased. Alternatives 0 and 1 were not considered for selection because these alternatives are not protective and do not meet ARARs. The Selected Remedy is judged to provide the best balance of the NCP remedy selection criteria of long-term effectiveness and permanence, reduction in toxicity, mobility or volume through treatment, short-term effectiveness, implementability, and cost. Based on an evaluation of the expected performance of the Selected Remedy against the NCP remedy selection criteria and its projected cost, the agencies have determined that the Selected Remedy is cost-effective.

This alternative also more closely adheres to the requirements of CERCLA and the NDEP Bureau of Mining Regulation and Reclamation closure requirements and guidance, which are required at active, permitted mines in Nevada. These closure requirements are important standards for closure of Abandoned Mine Land sites. The thickness of the cover is a minimum of 2 feet, which is consistent with current practices in Nevada for HLP closures. The ARARs are also met because leachate is controlled. Alternative 4 is more effective than Alternatives 2 and 3 with the addition of the routing of non-contact stormwater flow around the HLPs and FMS. Additional cost savings are realized due to reduction in O&M tasks related to the closure of ponds not needed to manage residual drain-down fluids. Phasing of Alternative 4 remedy construction and implementation is 2 to 3 years.

The Selected Remedy includes additional components that enhance the long-term effectiveness and protection of the remedy, including E-cells and stormwater management. At the appropriate time, some or all of the existing ponds will be converted to soil-filled double-lined E-cells, which eliminates open drain-down fluid surfaces that threaten wildlife. Interim stormwater management planning will be conducted and stormwater sediment basins will be constructed to contain runoff from a 100-year, 24-hour storm event – activities that increase protectiveness but were not included in other alternatives.

1.15.1 Cost Estimate for the Selected Remedy

Cost estimates were prepared consistent with EPA guidance which states that expected accuracy range of the cost estimate is –30 to +50 percent for detailed analysis of alternatives. Cost estimates developed during the detailed analysis phase are used to compare alternatives and support remedy selection. Cost was evaluated by considering relative capital and operating costs rather than detailed estimates. The costs for a process option relative to other process options of the same technology type were assessed by using engineering judgment and experience. Table 14 provides the cost estimate details for the Selected Remedy.

1.15.2 Estimated Outcomes of the Selected Remedy

This section discusses the risk reduction that will be achieved by implementing the Selected Remedy and the expected land use following implementation.

Human health risk from exposure to contaminated drain-down fluids and HLP materials will be eliminated or nearly eliminated by installation of the complete evaporative soil cover, maintaining existing Site access controls, recording access restrictions and engineering controls, and continuing FMS operations. Ecological risk from exposure to drain-down fluids will be reduced by maintaining existing wildlife deterrents and eventually closing the surface ponds. The potential for human health and ecological risk of exposure to contaminated windblown dust from the HLPs will be eliminated or nearly eliminated by installation of the complete evaporative soil cover. The cover will also eliminate or nearly eliminate the potential risk from ecological exposure to contaminated HLP material. Once the evaporative cover reduces infiltration into the HLPs, drain-down fluid generation rates will begin to decline. Although the volume of drain-down fluid will decrease over time, the drain-down fluid could contain higher metals concentrations because there will be less water flushing the salts out of the HLPs. Drain-down fluids will continue to be treated via passive evaporation and improved facilities, and treatment residuals will be disposed of on site. Solids generated by fluids evaporation from drain-down fluids will remain and could present exposure risks to human and ecological receptors until construction is complete and the HLPs are covered.

Upon implementation of the remedy, no change in land or resource use at the OU is anticipated. It is expected that the RAOs will be achieved by implementing the Selected Remedy. The remedial actions will be interim actions for OU-8 as this remedy only addresses the HLPs and the FMS. It does not address the pollutant and contaminant sources associated with the SX/EW Plant and the historical spill areas. The contaminated groundwater associated with the Arimetco facilities will be addressed as part of the RI/FS and remedial actions for site wide groundwater contamination in OU-1. Further study is required to define the nature and extent of contamination derived from the SX/EW Plant and historical spill areas and will be included in the final ROD for this OU. The action will be evaluated during five-year reviews to ensure that it continues to be protective of human health and the environment and complies with ARARs.

1.15.3 Statutory Determinations

Under CERCLA Section 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against off-site disposal of untreated wastes. The following subsections discuss how the Selected Remedy meets these statutory requirements.

1.15.3.1 Protection of Human Health and the Environment

The Selected Remedy, is expected to protect human health and the environment from exposure to contaminated drain-down fluids and HLP materials by installation of the complete evaporative soil cover, maintaining existing Site access controls, recording access restrictions and engineering controls, and continuing FMS operations. Ecological risk from exposure to drain-down fluids will be reduced by maintaining existing wildlife deterrents. The potential for human health and ecological exposure to contaminated windblown dust from the HLPs will be eliminated or nearly eliminated by installation of the complete evaporative soil cover. The cover will also eliminate or nearly eliminate the potential risk from ecological exposure to contaminated HLP material. The evaporative cover will reduce infiltration into the HLPs and drain-down fluid generation rates will begin to decline. Although the volume of drain-down fluid will decrease over time, the drain-down fluid could contain higher metals concentrations because there will be less water flushing the salts out of the HLPs. Drain-down fluids will continue to be treated via passive evaporation and improved facilities, and treatment residuals will be disposed of on-site.

1.15.3.2 Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d) of CERCLA, 42 United States Code Section 9621(d) requires that remedial actions at CERCLA sites attain (or justify the waiver of) any federal or state environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate. Federal ARARs may include requirements under any federal environmental laws. State ARARs include promulgated, enforceable environmental or facility-siting laws of general application that are more stringent or broader in scope than federal requirements.

Compliance with ARARs addresses whether a remedy will meet ARARs of other federal and state environmental statutes or provides a basis for invoking a waiver.

The agencies have evaluated and identified the ARARs for the Selected Remedy in accordance with CERCLA, the NCP, and EPA guidance, including the *CERCLA Compliance with Other Laws Manual: Interim Final* (EPA, 1988) and *CERCLA Compliance with Other Laws Manual: Part II, Clean Air Act and Other Environmental Statutes and State Requirements* (EPA, 1989). ARARs are summarized in Table 15. This alternative can be implemented to meet designated ARARs.

1.15.3.3 Cost-Effectiveness

The agencies have determined that the Selected Remedy is cost-effective and consistent with the NCP. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 Code of Federal Regulations Part 300.430(f)(1)(ii)(D)). The agencies made this determination by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. The overall effectiveness of the Selected Remedy was determined to be proportional to its projected costs and that this alternative represents a reasonable value for the money to be spent. Alternative 4 is effective at controlling potential human health and ecological risks from the HLP and drawdown fluids based on current and future land use. The costs for Alternative 4 are moderate compared to the other alternatives, and thus, are cost-effective.

1.15.3.4 Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The agencies have determined that the Selected Remedy represents the maximum extent to which permanent solutions can be utilized in a practicable manner at the Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Agencies have determined that the Selected Remedy provides the best balance of factors in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and bias against off-site treatment and disposal and considering community acceptance.

The Selected Remedy treats the source materials constituting principal threats at the Site, achieving significant reductions in drain-down fluid volumes. The Selected Remedy satisfies the criteria for long-term effectiveness by capping the HLPs, operating the FMS system to evaporate the drain-down fluids, and implementing Site access and institutional controls. The Selected Remedy does not present short-term risks different from the other treatment alternatives. There are no special implementability issues that set the Selected Remedy apart from any of the other alternatives evaluated.

1.15.3.5 Preference for Treatment as a Principal Element

The Selected Remedy satisfies the statutory preference for treatment as a principal element of the remedy.

The contaminated drain-down fluids from the HLPs are considered to be PTWs due their high levels of contaminants and their related toxicity to human health and environmental receptors. Under the Selected Remedy, these drain-down fluids will be collected and managed in the upgraded FMS, treated by passive evaporation and the solids from the evaporation ponds/basins will be managed by removal and reprocessing or in-place closure of the precipitates in the 4-Acre Pond.

The HLP materials are not considered to be PTWs due to the high volumes of the mine-related materials and low concentrations of metals and radionuclides. It would be impracticable to treat the HLP materials to the extent necessary to meet statutory preference for treatment of wastes to reduce their volumes or toxicity or permanently reduce mobility of contaminants. However, the Selected Remedy will reduce mobility of the HLP pollutants and contaminants by complete capping of the HLPs to contain the materials in-place, prevent direct contact, limit infiltration of meteoric water and reduce or eliminate the generation of acidic, metal-bearing drain-down fluids.

1.15.3.6 Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on-site, a statutory review will be conducted within five years after the completion of remedial action construction to ensure that the remedy is, or will be protective of human health and the environment. The five-year reviews will continue to ensure that the remedy is or will be protective of human health and the environment.

1.16 Documentation of Significant Changes from Preferred Remedy of Proposed Plan

No significant changes have been made in the Selected Remedy in this ROD from the Preferred Alternative presented in the Proposed Plan (EPA, 2016a).

1.17 References

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2.0 Responsiveness Summary

The Responsiveness Summary, the third component of this interim ROD, summarizes information about the views of the public and support agencies regarding both the remedial alternatives and general concerns about the site submitted during the public comment period. It also documents in the record how public comments were integrated into the decision-making process.

2.1 Stakeholder Issues and Lead Agencies Responses

The agencies prepared responses to comments submitted by the public during the Proposed Plan public comment period. The comments and responses are documented in Table 16.

2.2 Technical and Legal Issues

No technical or legal issues were identified during the public comment period.

Figures

Tables

Table 1
Summary of Arimetco Heap Leach Pad Construction Details

Feature	Phase I/II HLP 1988–1989a 1990–May 1997	Phase III South HLP August 1992–early 1997 (plus several months in 1998)	Phase III 4X HLP August 1995–1999	Phase IV Slot HLP March 1996–November 1998	Phase IV VLT HLP August 1998–November 1998
Material	Low-grade oxide ore (low-mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite, and trace metal sulfides) from the W-3 Dump VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock	Low-grade oxide ore (low- mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite, and trace metal sulfides) from the W-3 Dump MacArthur Pit run-of-mine and crushed ore (quartz monzonite with replacement minerals, such as chlorite and trace metal sulfides) VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock	Low-grade oxide ore (low- mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite, and trace metal sulfides) from the W-3 Dump MacArthur Pit run-of-mine and crushed ore (quartz monzonite with replacement minerals, such as chlorite, and trace metal sulfides) VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock	Low-grade oxide ore (low- mica quartz monzonite with some oxide alteration on joint faces and replacement minerals, such as chlorite, and trace metal sulfides) from the W-3 Dump VLT oxide tailings (2 to 10 feet thick) were placed on the bottom as drain rock	Oxide tailings from crusher MacArthur Pit run-of-mine and crushed ore (quartz monzonite with replacement minerals, such as chlorite, and trace metal sulfides) Phase III HLP material covers slope faces and benches to protect the finer VLT material from erosion
Particle Size and Sorting	6-inch-plus to silt size; poorly sorted	12-inch-plus to silt size; poorly sorted	12-inch-plus to silt size; poorly sorted	12-inch-plus blast rock to silt size; poorly sorted	0.5-inch-minus to sand-size crusher product
Historical Maximum Drain-down Rates (gpm)b	400 to 500	400 to 500	1,620	2,200	3,300
2006 Drain-down Rates (gpm)c	~ 1	Less than 4	Less than 3	Less than 10	Less than 10
Bottom Area (acres)b	14	46	50	86	54
Top Area (acres)b	3	15—two benches	22—three benches	37	29—two benches

Maximum Height (feet)	100	120	120	100	120
Approximate Volume (yd3)c	1,076,000	5,453,000	5,215,000	7,599,000	6,502,000
Wet/Dry Density (lb/ft3)c	120.7/114.4	137.8/128.4	132.1/123.0	114.7/108.9	141.1/130.9
Moisture Content (percent)c	5.7	7.7	8.0	6.3	7.5
Specific Gravity	2.74	2.73	2.72	2.75	2.69
Maximum Dry Density/ Optimum Moisture Content (lb/ft3/percent)c	142.8/5.5	140.1/6.5	140.0/6.0	193.3/5.7	141.0/6.1
Cohesion/Friction Angle (lb/ft2/degrees)c	955.7/41.2	1,304.6/40.0	1,710.5/41.9	875.8/40.6	745.7/41.3
Model Drain-down and Run-off (1.88 inches, 25-year/24-hour storm event) [gal]f	NA	445,392	280,653	297,959	499,191
Berms	East-west-lined berm in the middle of the two heaps A lined berm and solution ditch around the perimeter	A lined berm and solution ditch around the perimeter	A lined berm and solution ditch around the perimeter	A lined berm and solution ditch around the perimeter Berms within the heap	A lined berm and solution ditch around the perimeter Overlies finger ponds
Perimeter Ditches (~2.5 feet depth)	~3,500 feet linear; 8 feet width (average)	~5,500 feet linear; 14 feet width (average)	~5,800 feet linear; 27 feet width (average)	~7,600 feet linear; 14 feet width (average)	~5,300 feet linear; 18 feet width (average)
Slopesb	Gentle	Benched	benched	2.4H:1V	2.4H:1V

Table 1 (continued)
Summary of Arimetco Heap Leach Pad Construction Details

Feature	Phase I/II HLP 1988–1989a 1990–May 1997	Phase III South HLP August 1992–early 1997 (plus several months in 1998)	Phase III 4X HLP August 1995–1999	Phase IV Slot HLP March 1996–November 1998	Phase IV VLT HLP August 1998–November 1998
2010 Average Annual Drain-down Ratesd	Less than 1 gpm	Less than 5 gpm (combined rate for the Phase III South and Phase III 4X HLPs)		Less than 2 gpm	Less than 5 gpm
2016 Average Annual Drain-down Ratese	Less than 0.25 gpm	3.5 gpm		3.8 gpm	3.3 gpm

Notes:
[a] Don Tibbals originally constructed the Phase I HLP. When Arimetco purchased the Site in 1989, they expanded the operations into a contiguous pad, thereby constructing the Phase I/II HLP.
[b] Atlantic Richfield Company, 2002
[c] CH2M HILL, 2011a, Final Remedial Investigation Report Arimetco Facilities Operable Unit 8, Anaconda Copper Yerington Mine, September.
[d] Atlantic Richfield Company, 2010, Arimetco Heap Leach Fluid Management System Operations and Maintenance Plan, Yerington Mine Site, Prepared by Brown and Caldwell, July 16.
[e] Atlantic Richfield Company, 2016
[f] Brown and Caldwell, 2014

~	*approximately*
gal	*gallon*
gpm	*gallon per minute*
HLP	*heap leach pad*
lb/ft²	*pound per square foot*
lb/ft³	*pound per cubic foot*
NA	*not available*
VLT	*vat leach tailing*
yd³	*cubic yard*

Table 2
Summary of Fluid Management Pond Design Specifications

Description	Slot 2 Pond	Slot Sed. Pond	Phase I/II Pond	VLT Pond(1)	VLT Sed. Pond	EPA 4-Acre Pond (Evaporation Pond A)(3,4)	Evaporation Pond B	Evaporation Pond C	Total
Crest Area (square feet)	44,384	6,681	15,368	44,400	~9,000	179,903	46,854	46,854	393,444
Crest Area (acre)	1.02	0.15	0.35	1.02	~0.21	4.13	1.07	1.07	9.02
Total Depth (feet)	22	6	8	18	NA	10.15	10	10	N/A
Operational Maximum Water Depth (feet)	18	4	6	13	NA	9.16	9.0	9.0	N/A
Maximum Operational Capacity (million gallons)	2.6	0.14	0.43	1.9	0.053	10.6	2.4	2.4	20.5
Operational High Water Depth (feet)	18(2)	5	7	15.5	NA	9.16	9.0	9.0	N/A
Operational High Water Freeboard (feet)	3.0(2)	1	1	2.5	2.5	1	1	1	N/A
Highest Operational Capacity (acre-feet)	9.2	0.61	1.53	7.98	~0.16	32.7	7.5	7.5	67.6
Highest Operational Capacity (MG)	3.0	0.2	0.5	2.6	~0.053	10.6	2.4	2.4	21.8
Primary Drain-Down Sources(s)	Slot HLP	Slot HLP and Leak Detector	Phase I HLP	VLT HLP and Leak Detector	VLT HLP	All Ponds	Phase III HLP	Phase III HLP	N/A

Notes:

[1] VLT Pond storage capacity and surface area shown are after liner replacement.

[2] Current Slot Pond MOL and freeboard approved by EPA.

[3] Operational water level increased from 7 to 8 feet by EPA on December 6, 2010, and increased from 8 to 9 feet by EPA (letter entitled, "Approval of Operational Level Increase, Anaconda Yerington Mine Site/Arimetco Fluid Management System," Dated January 11, 2012.

[4] Fluid Management System Evaporation Pond A (EPA 4-Acre Pond) has no additional capacity due to the build-up of mineral salt precipitates. Replaced by Evaporation Ponds B and C.

~	*approximately*
EPA	*U.S. Environmental Protection Agency*
HLP	*heap leach pad*
MG	*million gallons*
MOL	*maximum operating level*
NA	*not available*
N/A	*not applicable*
Sed.	*sediment*
VLT	*vat leach tailing*

Table 3
Contaminants of Concern in Surface and Mixed-zone Heap Leach Pad Materials

Exposure Area	Contaminants of Concern
Surface Heap Leach Pad Materials	
Phase I/II Heap Leach Pad	Arsenic, Uranium-238
Phase III 4X Heap Leach Pad	Arsenic, Chromium, Radium-228, Uranium-238, Copper
Phase III South Heap Leach Pad	Arsenic, Uranium-238
Phase IV Slot Heap Leach Pad	Arsenic, Radium-228, Uranium-238, Copper
Phase IV VLT Heap Leach Pad	Arsenic, Chromium, Uranium-238, Copper, Cobalt
Mixed-zone Heap Leach Pad Materials	
Phase I/II Heap Leach Pad	Arsenic, Uranium-238
Phase III 4X Heap Leach Pad	Arsenic, Chromium, Radium-228, Uranium-238, Copper
Phase III South Heap Leach Pad	Arsenic, Radium-228, Uranium-238
Phase IV Slot Heap Leach Pad	Arsenic, Radium-228, Uranium-238
Phase IV VLT Heap Leach Pad	Arsenic, Chromium, Uranium-238, Copper, Cobalt
Drain-down Fluids	Arsenic, Chromium, Uranium

Notes:

Mixed-zone Materials: *samples collected from boreholes and included surface samples and subsurface composites (20-foot intervals with depths of 0 to 117 feet below ground surface)*

Surface Materials: *samples collected between 0.25 to 0.75 feet below ground surface*

VLT *vat leach tailings*

Table 4
Summary of Contaminants of Concern and Medium-Specific Exposure Point Concentrations

Exposure Area	Contaminant of Concern	Concentration		Units	Freq. of Detection	Exposure Point Conc.	Statistical Measure
		Minimum	Maximum				
Surface HLP Materials							
Phase I/II	Arsenic	9.1	26	mg/kg	4/4	26	Maximum
Phase I/II	Uranium-238	1.74	2.34	pCi/g	3/3	2.34	Maximum
Phase III 4X	Arsenic	6.8	24.8	mg/kg	8/8	16.94	95% Student-t UCL
Phase III 4X	Chromium	3.9	19.1	mg/kg	8/8	11.88	95% Approximate Gamma UCL
Phase III 4X	Radium-228	2.65	2.65	pCi/g	1/2	2.65	Maximum
Phase III 4X	Uranium-238	2.05	6.5	pCi/g	2/2	6.5	Maximum
Phase III 4X	Copper	520	8060	mg/kg	8/8	8060	Maximum
Phase III South	Arsenic	2.6	18.4	mg/kg	8/8	14.32	95% Student-t UCL
Phase III South	Uranium-238	0.977	2.72	pCi/g	2/2	2.72	Maximum
Phase IV Slot	Arsenic	8.7	31.6	mg/kg	10/10	19.38	95% Student-t UCL
Phase IV Slot	Radium-228	3.25	3.25	pCi/g	1/2	3.25	Maximum
Phase IV Slot	Uranium-238	2.47	2.8	pCi/g	2/2	2.8	Maximum
Phase IV Slot	Copper	543	7360	mg/kg	10/10	4765	95% Approximate Gamma UCL
Phase IV VLT	Arsenic	6	13.9	mg/kg	10/10	11.13	95% Student-t UCL
Phase IV VLT	Chromium	2.8	24.2	mg/kg	10/10	11.74	95% Approximate Gamma UCL

Phase IV VLT	Uranium-238	2.89	2.89	pCi/g	1/1	2.89	Maximum
Phase IV VLT	Copper	559	10400	mg/kg	10/10	5348	95% Approximate Gamma UCL

Table 4 (continued)
Summary of Contaminants of Concern and Medium-Specific Exposure Point Concentrations

Exposure Area	Contaminant of Concern	Concentration		Units	Freq. of Detection	Exposure Point Conc.	Statistical Measure
		Minimum	Maximum				
Phase IV VLT	Cobalt	6.1	69	mg/kg	8/10	33.71	95% KM (BCA) UCL
Mixed-zone HLP Materials							
Phase I/II	Arsenic	8.6	26	mg/kg	6/6	20.59	95% Student-t UCL
Phase I/II	Uranium-238	0.727	2.34	pCi/g	5/5	2.156	95% Student-t UCL
Phase III 4X	Arsenic	1.7	24.8	mg/kg	11/11	14.23	95% Student-t UCL
Phase III 4X	Chromium	2.7	19.1	mg/kg	11/11	9.861	95% Approximate Gamma UCL
Phase III 4X	Radium-228	1.47	2.65	pCi/g	3/5	2.375	95% KM (t) UCL
Phase III 4X	Uranium-238	1.21	6.5	pCi/g	5/5	6.218	95% Approximate Gamma UCL
Phase III 4X	Copper	520	8060	mg/kg	11/11	4709	95% Chebyshev (mean, sd) UCL
Phase III South	Arsenic	2.6	18.4	mg/kg	12/12	11.9	95% Student-t UCL
Phase III South	Radium-228	2.67	2.67	pCi/g	1/6	2.67	Maximum
Phase III South	Uranium-238	0.977	2.72	pCi/g	6/6	2.124	95% Approximate Gamma UCL
Phase IV Slot	Arsenic	4.4	31.6	mg/kg	15/15	16.26	95% Approximate Gamma UCL
Phase IV Slot	Radium-228	3.25	3.25	pCi/g	1/6	3.25	Maximum
Phase IV Slot	Uranium-238	0.977	2.72	pCi/g	6/6	2.118	95% Student-t UCL

Phase IV VLT	Arsenic	2.3	13.9	mg/kg	16/16	9.267	95% Student-t UCL
Phase IV VLT	Chromium	2.8	24.2	mg/kg	16/16	9.309	95% H UCL

Table 4 (continued)
Summary of Contaminants of Concern and Medium-Specific Exposure Point Concentrations

Exposure Area	Contaminant of Concern	Concentration		Units	Freq. of Detection	Exposure Point Conc.	Statistical Measure
		Minimum	Maximum				
Phase IV VLT	Uranium-238	1.49	2.89	pCi/g	4/4	2.89	Maximum
Phase IV VLT	Copper	559	10400	mg/kg	16/16	4951	95% Chebyshev (mean, sd) UCL
Phase IV VLT	Cobalt	5.6	69	mg/kg	16/16	35.48	95% KM (Chebyshev) UCL
Drain-down Fluids							
	Arsenic	73.8	209	µg/L	6/6	209	Maximum
	Chromium	771	3050	µg/L	13/13	3050	Maximum
	Uranium	1600	5000	µg/L	10/10	5000	Maximum

Notes:

Mixed-zone Materials: samples collected from boreholes and included surface samples and subsurface composites (20-foot intervals with depths of 0 to 117 feet below ground surface)

Surface Materials: samples collected between 0.25 to 0.75 feet below ground surface

%	*percent*
BCA	*bias-corrected accelerated bootstrap method*
Conc.	*concentration*
Freq.	*frequency*
HLP	*heap leach pad*
H-UCL	*UCL based upon Land's H-statistic*
KM	*Kaplan-Meier*
KM (Chebyshev)	*UCL based upon Kaplan-Meier estimates using the Chebyshev inequality*
KM (t)	*UCL based upon Kaplan-Meier estimates using the Student's t-distribution critical value*
mg/kg	*milligram per kilogram*

pCi/g	*picocurie per gram*
sd	*standard deviation*
UCL	*upper confidence limit*
VLT	*vat leach tailings*

Table 5
Carcinogenic Toxicity Parameters

Contaminant of Potential Concern[a]	Oral Slope Factor (mg/kg-day)$^{-1}$	Reference	Inhalation Unit Risk (µg/m^3)$^{-1}$	Reference	Mutagen (Yes/No)
Arsenic	1.50E+00	I	4.30E-03	I	--
Chromium	5.00E-01	J	8.40E-02	S	Yes
Cobalt	--	--	9.00E-03	P	--

Notes:

[a] *This table presents chemicals of concern for heap leach pads only.*

Surrogate: Toxicity value of hexavalent chromium used for chromium.

--	*Toxicity parameter is not available.*
µg/m^3	*microgram per cubic meter*
I	*Integrated Risk Information System Database (accessed September 21, 2012)*
J	*New Jersey value as listed on* Regional Screening Levels (RSLs)—Generic Tables *(U.S. Environmental Protection Agency, 2016b)*
mg/kg-day	*milligram per kilogram per day*
P	*Provisional Peer Reviewed Toxicity Values, 2011*
RfD	*reference dose*
S	*The Chromium(VI) specific inhalation RfD (assuming 100 percent Cr(VI)) is derived by multiplying the Integrated Risk Information System Chromium(VI) value by 7. This is considered to be a health-protective assumption, and is also consistent with the State of California's interpretation of the Mancuso study that forms the basis of Chromium(VI)'s estimated cancer potency.*

Table 6
Toxicity Parameters for Radionuclides of Concern

Radionuclide of Potential Concern[a]	Soil Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Lambda ($year^{-1}$)	Area Correction Factor (unit-less)
Radium-228	2.28E-09	5.18E-09	0.00E+00	1.21E-01	0.00E+00
Radium-228D	2.29E-09	5.23E-09	1.23E-05	1.21E-01	9.26E-01
Uranium-238	1.43E-10	9.32E-09	4.99E-11	1.55E-10	1.00E+00
Uranium-238D	2.10E-10	9.35E-09	1.14E-07	1.55E-10	9.79E-01

Notes:

[a] This table presents radionuclides of concern for heap leach pads only.

Source: Preliminary remediation goals for radionuclides (U.S. Environmental Protection Agency, 2010, Preliminary Goals for Radionuclides User's Guide).

pCi/g	*picocurie per gram*
risk/pCi	*risk per picocurie*
risk/yr	*risk per year*

Table 7
Noncancer Toxicity Data Summary

Contaminant of Potential Concern[a]	Chronic Oral Reference Dose (mg/kg-day)	Ref.	Chronic Inhalation Reference Conc. (mg/m^3)	Ref.	Sub-chronic Oral Reference Dose (mg/kg-day)	Ref.	Sub-chronic Inhalation Reference Conc. (mg/m^3)	Ref.	Primary Target Organs	Dermal Absorption Fraction
Arsenic	3.00E-04	I	1.50E-05	C	3.00E-04	H	--	--	Skin	0.03
Chromium	3.00E-03	I	1.00E-04	I	--	--	--	--	None	--
Cobalt	3.00E-04	P	6.00E-06	P	3.00E-03	P	2.00E-05	P	Thyroid	
Copper	4.00E-02	H	--	--	1.00E-02	A	--	--	Gastrointestinal system	--

Notes:

[a] *This table presents chemical of concern for heap leach pads only.*

Surrogate: Toxicity value of hexavalent chromium used for chromium.

--	*Toxicity parameter is not available.*
A	*Agency for Toxic Substances and Disease Registry Minimum Risk Levels, 2012*
C	*Office of Environmental Health Hazard Assessment Toxicity Criteria Database (accessed September 21, 2012)*
H	*Health Effect Assessment Summary Tables, 1997*
I	*Integrated Risk Information System Database (accessed September 21, 2012)*
mg/kg-day	*milligram per kilogram per day*
mg/m^3	*milligram per cubic meter*
P	*Provisional Peer Reviewed Toxicity Values, 2011*
Ref.	*reference*

Table 8
Incremental Risk Characterization Summary

Exposure Area Risk	Outdoor Worker			Indoor Worker			Construction Worker			Resident			Trespasser		
	Cancer Risk	Hazard Index	Primary Contributor(s)	Cancer Risk	Hazard Index	Primary Contributor(s)	Cancer Risk	Hazard Index	Primary Contributor(s)	Cancer Risk	Hazard Index	Primary Contributor(s)	Cancer Risk	Hazard Index	Primary Contributor(s)
Exposure to Surface Heap Leach Pad Material															
Phase I/II Heap Leach Pad	3.00E-05	0.2	Arsenic 19%, Radium-228 75%, Uranium-238 3%	1.00E-05	0.1	Arsenic 26%, Radium-228 67%	4.00E-06	1	Arsenic 17%, Chromium 31%, Radium-228 40$	5.00E-08	NR	N/A	1.00E-06	0.03	Radium-228 68%
Phase III 4X Heap Leach Pad	4.00E-05	0.3	Arsenic 10%, Chromium 3%, Radium-228 77%, Uranium-238 7%	2.00E-05	0.2	Arsenic 14%, Chromium 4%, Radium-228 72%, Uranium-238 7%	1.00E-05	2	Arsenic 7%, Chromium 47%, Radium-228 32%, Copper (noncancer) 73%	2.00E-07	NR	N/A	2.00E-06	0.05	Radium-228 73%
Phase III South Heap Leach Pad	NR	0.2	Arsenic 61%, Uranium-238 21%	NR	0.1	Arsenic 68%	NR	1	Arsenic 18%, Chromium 61%	4.00E-08	NR	N/A	NR	0.03	N/A
Phase IV Slot Heap Leach Pad	5.00E-05	0.3	Arsenic 10%, Chromium 2%, Radium-228 84%, Uranium-238 3%	2.00E-05	0.1	Arsenic 15%, Radium-228 79%	8.00E-06	2	Arsenic 10%, Chromium 30%, Radium-228 48%, Copper (noncancer) 49%	9.00E-08	NR	N/A	2.00E-06	0.04	Radium-228 80%
Phase IV VLT Heap Leach Pad	1.00E-05	0.4	Arsenic 11%, Chromium 5%, Radium-228 77%, Uranium-238 5%	7.00E-06	0.2	Arsenic 15%, Chromium 6%, Radium-228 71%	9.00E-06	2	Chromium 15%, Cobalt 15%, Radium-228 22%, Copper (noncancer) 49%	3.00E-07	NR	N/A	7.00E-07	0.06	Radium-228 70%
Exposure to Mixed-zone Heap Leach Pad Material															
Phase I/II Heap Leach Pad	2.00E-05	0.2	Arsenic 16%, Radium-228 78%, Uranium-238 3%	1.00E-05	0.09	Arsenic 23%, Radium-228 71%	4.00E-06	0.8	Arsenic 15%, Chromium 33%, Radium-228 41%	4.00E-08	NR	N/A	1.00E-06	0.03	Radium-228 72%
Phase III 4X Heap Leach Pad	3.00E-05	0.2	Arsenic 9%, Chromium 3%, Radium-228 78%, Uranium-238 7%	2.00E-05	0.1	Arsenic 14%, Chromium 4%, Radium-228 72%, Uranium-238 7%	8.00E-06	1	Arsenic 7%, Chromium 46%, Radium-228 34%, Copper (noncancer) 64%	2.00E-07	NR	N/A	1.00E-06	0.04	Radium-228 73%
Phase III South Heap Leach Pad	3.00E-05	0.2	Arsenic 8%, Chromium 2%, Radium-228 87%, Uranium-238 7%	1.00E-05	0.08	Arsenic 12%, Radium-228 83%	4.00E-06	0.8	Chromium 33%, Radium-228 50%	4.00E-08	NR	N/A	1.00E-06	0.03	Radium-228 83%
Phase IV Slot Heap Leach Pad	5.00E-05	0.2	Arsenic 9%, Chromium 1%, Radium-228 87%, Uranium-238 2%	2.00E-05	0.1	Arsenic 13%, Radium-228 82%	7.00E-06	1	Arsenic 9%, Chromium 30%, Radium-228 51%	7.00E-08	NR	N/A	2.00E-06	0.03	Radium-228 82%

Phase IV VLT Heap Leach Pad	2.00E-05	0.4	Arsenic 8%, Chromium 4%, Radium-228 82%, Uranium-238 4%	9.00E-06	0.2	Arsenic 11%, Radium-228 77%	8.00E-06	2	Chromium 43%, Cobalt 17%, Radium-228 28%, Copper (noncancer) 47%	2.00E-07	NR	N/A	9.00E-07	0.06	Radium-228 77%

Notes:

1. Primary contributors to total risk are listed when the chemical-specific risk is greater than 1E-6. Primary contributors to the hazard index are listed when hazard index is greater than 1. Percentages provided are contributions to cancer risks unless otherwise noted.

2. Incremental risk/hazard is calculated as the site risk/hazard minus the background risk/hazard (see Tables 5-1 through 5-5 for details).

3. Cancer risks are total chemical and radiological risks.

4. Hazard estimates are underestimated because uranium and TPH compounds are not included. See Section 6.0 Uncertainties for details.

Table 8 (continued)
Incremental Risk Characterization Summary

Mixed-zone Materials:	*samples collected from boreholes and included surface samples and subsurface composites (20 foot intervals with depths of 0 to 117 feet below ground surface)*
Surface Materials:	*samples collected between 0.25 to 0.75 feet below ground surface*
N/A	*not applicable*
NR	*No incremental risk or hazard is identified for this exposure area.*
TPH	*total petroleum hydrocarbons*
VLT	*vat leach tailings*

Table 9
Summary of 2008 Ecological Screening Results for Heap Leach Pad Surface Materials and Drain-down Solution

	Risks from HLP Surface Materials Soil				Risks from Drain-down Solution	
Analyte	**Plants**	**Invertebrates**	**Birds**	**Mammals**	**Birds**	**Mammals**
Metals (mg/kg)						
Aluminum	X=100%	-	X	X=100%	X	X
Antimony	NR	NR	-	X	-	-
Arsenic	X	X	X	X	NR	NR
Barium	NR	NR	-	NR	-	NR
Beryllium	NR	NR	-	NR	-	NR
Cadmium	NR	NR	X	X	NR	NR
Chromium (assumed 3+)	-	-	NR	NR	-	-
Chromium (assumed 6+)	-	-	-	NR	-	-

Chromium (total)	X=100%	X=100%	-	-	NR	NR
Cobalt	X	-	NR	NR	-	NR
Copper	X	X=100%	X=100%	X=100%	X	X
Lead	X	NR	X	X	-	-
Manganese	NR	NR	NR	NR	-	NR
Mercury	X=100%	X=100%	X-100%	X=100%	-	-
Molybdenum	X=100%	-	X=100%	X=100%	NR	NR
Nickel	NR	NR	NR	NR	-	NR
Selenium	X=100%	X	X=100%	X=100%	NR	NR
Silver	NR	-	NR	NR	-	-
Thallium	X	-	-	X	-	-
Vanadium						

	X=100%					
Zinc	NR	NR	X	X	NR	NR
Radionuclides (picocuries per gram)						
Thorium 227	NR	NR	NR	NR	NR	NR
Thorium 228	NR	NR	NR	NR	NR	NR
Thorium 230	NR	NR	NR	NR	NR	NR

Table 9 (continued)
Summary of 2008 Ecological Screening Results for Heap Leach Pad Surface Materials and Drain-down Solution

	Risks from HLP Surface Materials Soil				Risks from Drain-down Solution	
Analyte	**Plants**	**Invertebrates**	**Birds**	**Mammals**	**Birds**	**Mammals**
Thorium 232	NR	NR	NR	NR	NR	NR
Uranium 234	NR	NR	NR	NR	X	X
Uranium 235	NR	NR	NR	NR	NR	NR
Uranium 238	NR	NR	NR	NR	X	X

Notes:

- *no screening value; not evaluated mg/kg = milligrams per kilogram*
% *percent*
HLP *heap leach pad*
NR *no risk*
X *maximum exceeded screening value; X=100% means all samples exceeded screening value*

Table 10
Remedial Action Objectives and General Response Actions for the Protection of Human Health and Ecological Receptors

Subject	Remedial Action Objective	General Response Actions
HLP Materials and Drain-down Fluids	Prevent ingestion/direct contact with HLP materials and drain-down fluids containing COCs above human-health risk-based levels	Implementation of site access restrictions and wildlife deterrents Containment of HLP materials Containment of drain-down fluids Reduction in volume of drain-down fluids through evaporative treatment
	Minimize exposure to HLP materials and drain-down fluids containing COECs at levels that are harmful to ecological receptors	Removal and disposal of salts from evaporation ponds
Groundwater	Maximize groundwater protection by preventing migration of drain-down fluids to groundwater at levels above federal MCLs	Containment of drain-down fluids and reduction in volume through evaporation Reducing future volume of drain-down fluid by minimizing infiltration into HLPs

Notes:

COC	*contaminant of concern*
COEC	*contaminant of ecological concern*
HLP	*heap leach pad*
MCL	*maximum contaminant level*

Table 11
Description of Remedial Alternatives

Remedial Alternative		Description
Alternative 1—No Further Action Alternative		No additional action. Includes the continuation of the following ongoing activities and limited additional controls: FMS operations (including fluids management and continued passive evaporation of fluids in ponds) HLP perimeter ditch rehabilitation, operations and maintenance Site access controls Wildlife deterrents for all ponds (e.g., noise makers, netting, covers, and fencing) Additional Access Restrictions
Alternative 2— Passive Evaporation and Top Capping of HLPs		Includes the continuation of all activities of Alternative 1 Recording of access restrictions and engineering controls
	FMS	Construction of a 2-acre concrete basin for solids dewatering/management Closure of all existing ponds other than the 4-Acre Pond Construction of berm across the middle of 4-Acre Pond to split it into two cells Replacement of 4-Acre Pond liner once after 5 years Leak detection monitoring Solids disposed of in New On-site Repository
	HLPs	Sealants/sprays for dust control would be used on HLP side slopes.

		Top-deck grading and installation of 4-foot-thick soil cover on top deck to minimize infiltration through storage and evaporation.
Alternative 3—Passive Evaporation and Complete Capping of HLPs		Includes the continuation of all activities of Alternative 1 plus the recording of access restrictions and engineering controls of Alternative 2
	FMS	Includes all FMS elements of Alternative 2
	HLPs	Re-grading/re-shaping and capping the entire HLP surfaces (4-foot-thick ET soil cover) to minimize infiltration and eliminate the need for sealants and sprays for dust control on the side slopes of the HLPs

Table 11 (continued)
Description of Remedial Alternatives

Remedial Alternative		Description
Alternative 4—Modified Evaporation, Complete Capping of HLPs, Pond Conversion to E-cells, and Stormwater Management		Includes the continuation of all activities of Alternative 1 plus the recording of access restrictions and engineering controls as in Alternatives 2 and 3
	FMS	Replaces the new 2-acre basin (Alternatives 2 and 3) with reprocessing and removal, or in-place closure of precipitates in the existing 4-Acre Pond; install four new sedimentation basins Conversion of existing ponds to E-cells in the future
	Stormwater	A series of trapezoidal channels will be used to convey stormwater from the closed HLPs to sedimentation basins (as many as four). The system will be designed to contain runoff from a 100-year 24-hour storm event. This interim system will eventually link to a site-wide system.
	HLPs	Top surface re-grading and slope re-grading/reshaping and capping entire HLP surfaces (minimum 2-foot-thick ET soil cover) to minimize infiltration and eliminate the need for sealants and sprays for dust control on the side slopes of the HLPs

Notes:

ET	*evapotranspiration*
FMS	*Fluid Management System*
HLP	*heap leach pad*

Table 12
CERCLA Criteria Matrix for Detailed Analysis and Comparative Analysis of Remedial Alternatives

Remedial Alternative	Major Components	Threshold Criteria		Balancing Criteria				
		Overall Protection of Human Health and the Environment	Compliance with Surface Water and Soil ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility and Volume	Short-term Effectiveness	Implementability	Total 30-year NPV ($)
Alternative 1 (No Further Action Alternative)	No additional action. Includes the continuation of the following current activities: FMS operations. Perimeter ditch inspection, maintenance and rehab. Site access controls. Wildlife deterrents for all ponds. Continued passive evaporation of fluids in existing ponds.	Some RAOs would be achieved. Risk of human and ecological exposure to contaminated fluids and human exposure to contaminated soil would be the same as exists under current conditions. No action would be taken to protect groundwater or prevent ecological exposure to contaminated soil.	Would only comply with ARARs to the extent that the existing infrastructure of ponds and HLPs meet Nevada Administrative Code requirements for groundwater protectiveness and containment of heap leach materials. HLP closure requirements would not be met.	Future risks to human health and the environment would not be diminished compared to current levels (described by the RAOs).	Contaminated fluids volume would be reduced to the degree that passive evaporation in the existing ponds exceeds drain-down, but the contaminant mass in the ponds would remain the same. Precipitated solids would be generated as a treatment residual of evaporation. The treatment reaction (evaporation) is considered to be reversible because new fluids entering the ponds could re-dissolve precipitated solids.	No additional short-term risks to the community, workers, or environment associated with alternative implementation.	Implementable. Currently being implemented. Estimated time for construction and implementation of Alternative 1 remedy is 1 year.	2,142,700
Alternative 2 (Passive Evaporation and Top Capping of HLPs)	All elements of Alternative 1 HLP dust control. Leak detection monitoring and reporting. Replacement of 4-Acre Pond liner. Construction of a berm across the middle of the 4-Acre Pond to split it into two cells. This would be done to	Degree of protectiveness considerably higher than Alternative 1 because the evaporative soil cover would eliminate or nearly eliminate infiltration into the HLPs and stormwater	Would likely comply with ARARs by upgrading FMSs to meet Nevada Administrative Code requirements for groundwater protectiveness. Would likely comply	Alternative 2 is expected to effectively upgrade FMS operations to assure containment and passive evaporation treatment of drain-down fluids. Provides key improvements to long-term effectiveness over	Considerable reduction in mobility and volume of drain-down fluids contamination through evaporation. The toxicity of the contaminants in the ponds would	Modest to high short-term effects. As with Alternatives 3 and 4, dust control measures would likely	Similar to Alternatives 3 and 4, but significantly more difficult to implement than Alternative 1 because of the site access and coordination requirements associated with identifying, excavating, transporting, and placing the cover	29,695,000

	facilitate management of the fluids in the 4-Acre Pond, to address the required solids removal and liner replacement. Construction of a new concrete basin. It is assumed that the total hydraulic capacity of the new basin would be two million gallons, with a surface area of 2 acres. Closure of all existing ponds (except the 4-Acre Pond) using a 2-foot on-site soil cover. Disposal of solids from evaporation ponds/basins in a new on-site repository sized to accommodate the expected solids volume. HLP top-deck grading.	runoff from the HLPs. This alternative would eventually result in a lower flow rate of drain-down fluid coming out the bottom of the HLPs; however, time to clean up may not be decreased. Protectiveness would also be increased by reducing the risk of ecological and human exposure to contaminated HLP materials via the 4-foot-thick soil cover.	with HLP closure requirements.	Alternative1 by closing older ponds and actively managing solids accumulating during evaporation. Use of the new basin and dividing the 4-Acre Pond would improve process efficiencies for managing fluids and solids. Landfilling of salts would remove them from human and ecological contact. HLP grading and evaporative soil cover provide effective containment and long-term permanence related to HLP closure. Also the reduced infiltration and sealant application	decrease as solids are removed. Although installation of the HLP covers would reduce infiltration rates, the treatment process (evaporation) is the same as the other alternatives and the ultimate volume of contaminants may not change.	be required during remedial activities to prevent community and worker risk or environmental impacts. Workers would also require proper PPE to avoid dust inhalation. Short-term risks are anticipated to be greater than for Alternative 1 because of the significant grading and dirt hauling operations.	material. Estimated time for construction and implementation of Alternative 2 remedy is 2 years.	

Table 12 (continued)
CERCLA Criteria Matrix for Detailed Analysis and Comparative Analysis of Remedial Alternatives

Remedial Alternative	Major Components	Threshold Criteria		Balancing Criteria				
		Overall Protection of Human Health and the Environment	Compliance with Surface Water and Soil ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility and Volume	Short-term Effectiveness	Implementability	Total 30-year NPV ($)
	Installation of 4-foot-thick cover on top deck to minimize infiltration through storage and evaporation.			should significantly reduce the flow rate of drain-down fluids, although it is not expected to decrease the remediation timeframe significantly (because it would also reduce the rates that contaminants are flushed from the HLPs).				
Alternative 3 (Passive Evaporation and Complete Capping of HLPs)	All elements of Alternative 1 HLP dust control. Leak detection monitoring and reporting. Replacement of 4-Acre Pond liner. Construction of a berm across the middle of the 4-Acre Pond to split it into two cells. This would be done to facilitate management of the fluids in the 4-Acre Pond to address the required solids removal and liner replacement. Construction of a new concrete basin. It is assumed that the total hydraulic capacity of the new basin would be two million gallons with a surface area of 2 acres. Closure of all existing ponds (except the 4-Acre Pond) using a 2-foot on-site soil cover. Disposal of solids from evaporation ponds/basins in a new on-site repository sized to accommodate the	Degree of protectiveness considerably higher than all other alternatives because the ET soil cover would eliminate or nearly eliminate infiltration into the HLPs and stormwater runoff from the HLPs and would provide a complete barrier over the HLP materials, eliminating risks to humans and ecological receptors from direct contact with HLP materials.	Would comply with ARARs by upgrading FMSs to meet Nevada Administrative Code requirements for groundwater protectiveness. Has the greatest potential to comply with HLP closure requirements.	Similar to Alternative 2. However, complete capping versus capping of only the top deck (as in Alternative 2) would increase the effectiveness and permanence of the action.	Same as Alternative 2. Although installation of the HLP covers would reduce infiltration rates, the treatment process (evaporation) is the same as the other alternatives and the ultimate volume of contaminants may not change.	Moderate to high short-term effects. As with Alternatives 2 and 4, dust control measures would be required during remedial activities to prevent community and worker risk or environmental impacts. Workers would also require proper PPE to avoid dust inhalation. However, this alternative has the greatest amount of grading and dirt hauling operations, considerably increasing	Considered to be more difficult to implement than other alternatives because of the large volumes of material that would need to be moved for grading and cover placement. Maintenance of the vegetative cover could also prove challenging due to wind, temperature, and general aridity of the area. Estimated time for construction and implementation of Alternative 3 remedy is 2 years.	58,231,000

	expected solids volume. Re-grading/re-shaping and capping (4-foot-thick ET soil cover) to minimize infiltration.					potential short-term risks to workers and the community and requiring implementation of more aggressive dust control measures.		
Alternative 4 (Modified Evaporation, Complete Capping of HLPs, Pond Conversion to E-cells, and Stormwater Management)	All elements of Alternative 1 Leak detection monitoring and reporting. Reshaping and re-grading the HLP tops and side slopes. Placement of a minimum 2-foot-thick soil cover over the entire re-graded pad to minimize infiltration.	Similar to Alternative 3. The degree of protectiveness is considerably higher than the other alternatives because the ET soil cover would eliminate or nearly eliminate infiltration into the HLPs and stormwater	Similar to Alternative 3. Would comply with ARARs by upgrading FMSs to meet Nevada Administrative Code requirements for groundwater protectiveness and has the greatest potential to comply with HLP closure requirements.	Similar to Alternative 3. The use of complete capping versus capping of only the top deck (as in Alternative 2) would increase the effectiveness and permanence of the action. Although the cap is a minimum of 2 feet thick compared to 4 feet thick in Alternative 3, the	Similar to Alternative 3. Conversion of most of the existing ponds to E-cells under this alternative would provide additional treatment through evaporation at the ponds. This pond conversion is not addressed under the	Moderate to high short- term effects. As with Alternatives 2 and 3, dust control measures would be required during remedial activities to prevent community and worker risk or environmental impacts. Workers would also require proper PPE to avoid dust inhalation.	Similar to Alternative 3 to implement, although the volumes of material that would need to be moved for grading and cover placement has been reduced. Maintenance of the vegetative cover could also prove challenging due to wind, temperature, and general aridity of the area.	36,111,000

Table 12 (continued)
CERCLA Criteria Matrix for Detailed Analysis and Comparative Analysis of Remedial Alternatives

Remedial Alternative	Major Components	Threshold Criteria		Balancing Criteria				
		Overall Protection of Human Health and the Environment	Compliance with Surface Water and Soil ARARs	Long-term Effectiveness and Permanence	Reduction in Toxicity, Mobility and Volume	Short-term Effectiveness	Implementability	Total 30-year NPV ($)
	Construction of four stormwater sedimentation basins designed to contain a 100-year 24-hour storm event. Interim Stormwater Management Planning. Conversion of existing ponds to E-Cells. Disposal of solids from evaporation ponds/basins by reprocessing and	runoff from the HLPs and would provide a complete barrier over the HLP materials, eliminating risks to humans and ecological receptors from direct contact with HLP materials. The thickness of the cap is reduced to a		thickness is consistent with the current practices for HLP closure in Nevada and is considered effective and permanent. Monitoring and inspections will be performed and repairs as needed if erosion or leakage are detected. Also includes conversion of most of the existing ponds	other alternatives.	The amount of grading and dirt hauling is considerably less than that required for Alternative 3 which reduces potential short- term risks to workers.		

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	removal or in-place closure of the precipitates in the 4-Acre Pond. 4-Acre Pond Closure. The existing 4-Acre Pond will either be closed in-place by removal and reprocessing of the pond inventory or encapsulation liner installation and placement of a soil over-liner layer with over-liner infiltration drains.	minimum of 2 feet compared to Alternative 3 but consistent with current practices in Nevada for HLP closures. Also includes conversion of most of the existing ponds to E-cells providing additional protectiveness.		to E-cells providing additional long-term effectiveness and permanence.					

Notes:

ARAR	*applicable or relevant and appropriate requirement*
ET	*evapotranspiration*
FMS	*Fluid Management System*
HLP	*heap leach pad*
NPV	*net present value*
PPE	*personal protective equipment*
RAO	*remedial action objective*

Table 13
Cost Summary for Remedial Alternatives

Remedial Alternative	Capital Cost ($)	Annual O&M and Monitoring Costs ($)	Total 30-year NPV[a] ($)
Alternative 1—No Further Action Alternative	1,740	168,500	2,142,700
Alternative 2—Passive Evaporation and Top Capping of HLPs Solids Disposed of in New On-site Repository	21,128,500	686,300	29,695,000
Alternative 3—Passive Evaporation and Complete Capping of HLPs Solids Disposed of in New On-site Repository	51,738,000	519,200	58,231,000
Alternative 4—Modified Evaporation, Complete Capping of HLPs, Pond Conversion to E-cells and Stormwater Management	30,428,000	381,700	36,111,000

Notes:

[a] NPV estimates use a real discount rate of 7 percent.

All costs are +50 percent/-30 percent and rounded to the nearest $1,000.

HLP	*heap leach pad*
NPV	*net present value*
O&M	*operation and maintenance*

Table 14
Alternative 4 (Selected Remedy) Cost Estimate Summary[1]

Component Description	Quantity	Unit Price	Component Cost	Number of Events	Present Worth[7]
Capital Costs					
Phase I/II[2]	1	$2,395,000			$2,395,000
Phase III-So[2]	1	$4,644,000			$4,644,000
Phase III-4x[2]	1	$3,425,000			$3,425,000
Phase IV-Slot[2]	1	$4,741,000			$4,741,000
Phase IV-VLT[2]	1	$4,354,000			$4,354,000
Sedimentation Basins[2]	1	$1,469,000			$1,469,000
4-Acre Pond (Evaporation Pond A)[2]	1	$1,365,000			$1,365,000
ET Cell Conversions[2]	1	$493,000			$493,000
Subtotal					**$22,886,000**
Indirect Capital Costs					
Detailed Design and Construction Drawings, Technical Specifications, CQA Manual[2]	3.0%		$671,790		$671,800
Engineer-of-Record Oversight and As-Built Reporting[2]	3.0%		$671,790		$671,800
Construction Quality Assurance (including as-built surveying)[2]	5.0%		$1,119,650		$1,119,700
Bid Process and Project Administration[2]	5.0%		$1,119,650		$1,119,700
Contingency[2]					

	15.0%		$3,358,950		$3,359,000
Additional Tasks to Support Sitewide Closure[(2)]	2.0%		$447,860		$447,900
Separate Design and Construction-Related Costs for ET Cell Conversion[(2)]			$152,000		$152,000
Subtotal					**$7,542,000**
Capital Cost Total					**$30,428,000**

Table14 (continued)
Alternative 4 (Selected Remedy) Cost Estimate Summary[1]

Component Description	Quantity	Unit Price	Component Cost	Number of Events	Present Worth[7]
Operation and Maintenance Costs					
Stormwater Monitoring/Sampling[3] (years 1 through 5)	1	$11,600	$11,600	5	$47,600
Excavation of Soil to Repository[4]	1	$54,433	$54,500	30	$676,300
Continued FMS Operations[5] [6]	1	$79,748	$79,800	30	$990,300
Land Use Controls/Access Restrictions[5]	1	$4,400	$4,400	30	$54,600
Wildlife Deterrents for All Ponds[5]	1	$48,200	$48,200	30	$598,200
HLP Cover Inspection and Repair[1]					
Inspection Labor	6	$190	$1,200	30	$14,900
Repairs—3% of final cover placement cost[8]	3%	$5,370,500	$161,200	30	$2,000,400
4-Acre Pond Cap Inspection and Repair[1]					
Inspection Labor	4	$190	$800	30	$10,000
Repairs—3% of final cover placement cost[8] [9]	3%	$327,400	$9,900	30	$122,900
Sed Basin 1 Liner Inspection and Repair[1]					
Inspection Labor	4	$190	$800	30	$10,000
Repairs—3% of liner installation cost[8]	3%	$54,800	$1,700	30	$21,100
(Basins 2, 3, and 4 do not have liners)					
Evaporation Cells Liner Inspection and Repair[1]					

Inspection Labor	8	$190	$1,600	30	$19,900
Repairs—3% of liner and piping installation cost[10]	3%	$199,100	$6,000	30	$74,500
Component Annual Cost Subtotal			**$381,700**		

Table 14 (continued)
Alternative 4 (Selected Remedy) Cost Estimate Summary[(1)]

Component Description	Quantity	Unit Price	Component Cost	Number of Events	Present Worth[(7)]
Implementation Costs					
Project Management	5%	$381,700	$19,100	30	$237,100
Health and Safety	1%	$381,700	$3,900	30	$48,400
Undefined Scope and Market Allowance	10%	$381,700	$38,200	30	$474,100
Fee	5%	$381,700	$19,100	30	$237,100
Five-Year Review[(5)] (occurs in years 5, 10, 15, 20, 25, 30)	1	$21,000	$21,000	6	$45,400
O&M Subtotal					**$5,683,000**
Total 30 Year Present Worth Cost of Capital and O&M					**$36,111,000**

Notes:

[1] Table intended to provide an O&M and Capital Cost Estimate assembled by similar methods, and thus comparable to, those provided for the other alternatives. The limitations in detail of those estimates also apply to Alternative 4.

[2] Component construction or capital cost taken from Table 10.1 and Appendix C of SRK Consulting, Inc., 2015, Yerington Mine Operable Unit 8, Focused Feasibility Study Conceptual Closure Plan, Prepared for Nevada Division of Environmental Protection, Bureau of Corrective Actions, March 2015.

[3] Annual cost taken from Appendix D, Tables D-7 and D-9, of the Feasibility Study. Costs for storm water handling are not included (other than Basin 1 liner maintenance)to be consistent.

[4] Alternative 4 does not include a repository for Pond A (4-Acre Pond) sediments/salts. However, ongoing handling/management of sediments is not detailed. This O&M cost is included as an allowance for ongoing sediment/salts handling/management costs.

[5] Annual cost taken from Appendix D, Tables D-7 and D-9, of the Feasibility Study.

[6] Assumed to include all anticipated FMS operations costs, including flow measurement and monitoring. Assumed applicable to Alternative 4 drain-down collection system.

[7] Discount rate from EPA 540-R-00-002, Section 4.3: 7.0%

Discount rate for 2016 is 1.5% (https://www.frbdiscountwindow.org/en/Pages/Discount-Rates/Current-Discount-Rates.aspx). A rate of 7% was maintained in these updated calculations for consistency with the other alternatives.

[8] For these items, annual O&M cost of 3% of soil cover placement cost or liner placement cost assumed.

[9] *Timing of 4-Acre Pond closure not specified, so to be conservative, a full 30 years of O&M assumed. O&M period will necessarily be less.*
[10] *For this item, annual O&M cost of 3% of evaporation cell liner, piping, and backfill assumed.*

Table 14 (continued)
Alternative 4 (Selected Remedy) Cost Estimate Summary[1]

%	*percent*
CQA	*construction quality assurance*
EPA	*U.S. Environmental Protection Agency*
ET	*evapotranspiration*
FMS	*Fluid Management System*
HLP	*heap leach pad*
O&M	*operation and maintenance*
Sed	*sediment*
VLT	*vat leach tailing*

Table 15
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
Groundwater					
NAC 445A.144, Water Controls (Safe Drinking Water Act of 1974 as amended)					
NAC 445A, "Water Controls," which adopts by reference 40 CFR 141, "National Primary Drinking Water Regulations" (including 40 CFR 141.62, "Maximum Contaminant Levels for Inorganic Contaminants," and 40 CFR 141.66, "Maximum Contaminant Levels for Radionuclides")	Chemical	All groundwater in Nevada is considered a potential source of drinking water. Consequently, the state adopts by reference the federal Safe Drinking Water Act in NAC 445 A. The regulating authority is NDEP.	In Nevada, MCLs are applied when evaluating potential impacts of different pollutant sources, setting remediation or cleanup actions levels, and establishing protective groundwater levels. Closure of heaps and ponds and construction of new waste repositories or fluid impoundments are being evaluated as potential remedial measures that, if selected, will need to be protective of groundwater.	Relevant and appropriate	Design, construction, operation, and closure of any waste repositories or fluid impoundments that could adversely affect groundwater.
NAC 445A, Contamination of Groundwater					
NAC 445A.22735, "Contamination of Groundwater: Establishment of Action Levels" NAC 445A.2274, "Remediation Standard"	Chemical	Action levels for groundwater must be established under the following circumstances: Presence of a hazardous substance, hazardous waste, or a regulated substance in groundwater at a level of concentration equal to MCL.	Groundwater in Arimetco OU-8 contains some contaminants that exceed corresponding MCLs. Closure of heaps and ponds, and construction of new waste repositories or fluid impoundments are	Relevant and appropriate	Design, construction, operation, and closure of any waste repositories or fluid impoundments that could adversely affect groundwater.

		Concentration of a hazardous substance, hazardous waste, or a regulated substance is equal to the background concentration and that level of concentration is greater than	being evaluated as potential remedial measures that, if selected, will need to be protective of groundwater.		

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
		the MCL.			
NAC 534, Regulations for Water Well and Related Drilling					
NAC 534.360 through NAC 534.438, "Drilling, Construction and Plugging of Wells and Boreholes"	Action	Identifies well and borehole drilling, construction, and abandonment requirements.	Groundwater monitoring wells and borings may be installed as a result of Arimetco OU-8 remedies.	Applicable	Remediation activities that require siting, installation, construction, operation, maintenance, and decommissioning of wells and boreholes.
Radionuclide ARAR Dose Compliance Concentrations for Superfund Sites					
OSWER Directive 9200.4-18, *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination; OSWER Directive 9200.4-31P, Radiation Risk Assessment CERCLA Sites: Q&A; OSWER Directive 9285.6-20, Distribution of the "Radiation Risk Assessment at CERCLA Sites: Q&A"*	Chemical	This memorandum (OSWER 9200.4-18) presents clarification for establishing protective cleanup levels in media for radioactive contamination at CERCLA sites. EPA has determined that the dose limits established by the NRC in 62 FR 39058 generally will not provide a protective basis for establishing PRGs under CERCLA. OSWER 9285.6-20 (*Distribution of the "Radiation Risk Assessment at CERCLA Sites: Q&A"*) replaces the previous directive, OSWER 9200.4-	Arimetco OU-8 contains radioactive contaminants.	TBC	Closure of heaps and ponds, construction of new waste repositories, or fluid impoundments that could adversely affect groundwater.

		31P. It provides answers to several commonly asked questions regarding risk assessments at radioactively contaminated sites. In addition, the directive changes the Superfund recommendation on what			

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
		is considered to be a protective dose-based ARAR.			
Surface Water					
Clean Water Act of 1977 (33 USC 1251 et seq., as amended)					
40 CFR 131.10, National Recommended Water Quality Criteria [Ambient Water Quality Criteria]—2015	Chemical	Establishes numeric water quality criteria for the protection of human health and aquatic organisms. The human health criteria were updated in 2015 to incorporate current information regarding exposure factors and toxicity data. Toxic criteria for the protection of aquatic life is provided in the water quality criteria regulations 40 CFR 131.36(b)(1), "EPA's Section 04(a), Criteria for Priority Toxic Pollutants," which supersede criteria adopted by the state, except where the state criteria are more stringent than the federal criteria.	Closure of heaps and ponds and construction of new waste repositories or fluid impoundments are being evaluated as potential remedial measures that, if selected, will need to be protective of surface water.	Relevant and appropriate	Remediation activities that affect surface water.
NAC 445A.11704,	Chemical	Construction activities	Closure of heaps and	Relevant	Permits are not required,

"Standards for Water Quality" NAC 445A.121, "Standards Applicable to All Surface Waters"		defined under 40 CFR 122.26(b)(14), "Stormwater Discharge Associated with Industrial Activity," applying to projects disturbing at least 1 acre, or will disturb less than 1 acre but are part of a larger common plan for development or sale that will ultimately disturb one or more acres.	ponds and construction of new waste repositories or fluid impoundments are being evaluated as potential remedial measures that, if selected, will need to be protective of surface water.	and appropriate	but the substantive requirements such as installation and maintenance of best management practices (diversion ditches, detention basins, erosion control, sediment traps, gravel construction entrances,

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
					covered storage, and spill response) to remedial actions that can cause stormwater pollution need to be met. *Nevada Contractors Field Guide for Construction Site Best Management Practices (BMPs)* provides guidance for BMPs.
Soil					
EPA Regional Screening Levels					
EPA Regional Screening Levels (RSLs) for Chemical Contaminants at Superfund Sites; available on-line and updated every 6 months	Chemical	The RSLs are chemical-specific concentrations of individual constituents in soil that may warrant further investigation or site cleanup. These values are risk-based and derived using standardized equations combining exposure assumptions with EPA toxicity data.	Soil in Arimetco OU-8 contains contaminants that require remediation. Comparison to soil screening levels may be appropriate for defining potential contaminants of concern and for considering cleanup criteria.	TBC	Soil cleanup actions to protect human health receptors.
OSWER Directives					
OSWER Directive 9285.7-55, *Guidance*	Chemical	Provides a set of risk-based soil screening levels for	Soil in Arimetco OU-8 contains contaminants that	TBC	Soil cleanup actions to protect ecological

for Developing Ecological Soil Screening Levels		several soil contaminants that are of ecological concern for terrestrial plants and animals at hazardous waste sites. It also describes the process used to derive these levels and provides guidance for their use.	require remediation. Comparison to soil screening levels may be appropriate for defining potential contaminants of concern and for considering cleanup criteria.		receptors.

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
OSWER Directive 9200.4-18, *Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination* OSWER Directive 9285.6-20, *Distribution of OSWER Radiation Risk Assessment at CERCLA Sites Q&A's* replaces OSWER Directive 9200.4-31P, *Distribution of OSWER Radiation Risk Assessment Q&A's Final Guidance*	Chemical	This memorandum presents clarification for establishing protective cleanup levels in media for radioactive contamination at CERCLA sites. In the final guidance, EPA further clarifies that 12 millirem per year is not a presumptive cleanup level under CERCLA. Rather, site decision makers should continue to use the CERCLA risk range when ARARs are not used to set cleanup levels.	Media from Arimetco OU-8 that contain radioactive contaminants that, if not remediated, may pose a risk to human health or the environment.	TBC	Development of media cleanup levels.
NAC 445A, Contamination of Soil					
NAC 445A.227, "Contamination of Soil" 2271—"Plan and Schedule for Completing Corrective Action"	Action and chemical	Establishes corrective action requirements for soil after the release of a hazardous substance, hazardous waste, or regulated substance. An action level for soil must be established at the	Soil in Arimetco OU-8 contains contaminants that require remediation. Applying the procedures for establishing soil action levels, which are not promulgated criteria, are applicable.	Relevant and Appropriate	Development of soil action levels. Development of soil

22715—"Waiver of Requirements" 2272—"Establishment of Action Levels"		following levels: Levels of hazardous substances in excess of background concentrations. Levels of petroleum in soil in excess of 100 milligrams per kilogram.	Applying the procedures for establishing soil action levels, which are not promulgated criteria, are not applicable for HLPs.	Relevant and appropriate	action levels is not applicable for HLP materials.

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
		If the potential for human exposure or damage to the environment is from contaminated surface water or groundwater, levels of hazardous substance in excess of the maximum threshold concentration listed in the Toxicity Characteristics Leaching Rule, 40 CFR 61.24. If inhalation, ingestion, or dermal exposure is the primary pathway of concern or an applicable level of concentration is not listed in the Toxicity Characteristics Leaching Rule, then the action level in soil must meet a concentration based on the protection of public health and safety and the environment that is determined by NDEP using the Integrated Risk Information System, adopted by EPA. If more than one action level for soil is needed, the most restrictive action level must			

		be used (but not more restrictive than background).			
Air					
Clean Air Act of 1977; 40 CFR 60, "Standards of Performance for New Stationary Sources"					
40 CFR 60, "Standards of Performance for New Stationary Sources"	Action and chemical	Applies to specific stationary sources that emit toxic air pollutants where construction or modification	Hazardous contaminants detected that include constituents that would constitute hazardous	Relevant and appropriate	Remediation activities that have the potential to emit regulated hazardous air pollutants and

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
		of the facility commences after the effective date of any standard promulgated in this regulation.	air pollutants if released to the air.		are considered a new source.
Clean Air Act of 1977; 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants," Subpart A, "General Provisions"					
40 CFR 61.05, "Prohibited Activities"	Action and chemical	Identifies prohibited activities from stationary sources of air pollutants including operating a stationary source that is in violation of any national emission standard unless specifically exempted; or operating any existing source that is subject to national emission standards, in violation of the standards.	Hazardous contaminants that include constituents that would be subject to NESHAP requirements if released to the air.	Relevant and appropriate	Remediation activities that have the potential to emit regulated hazardous air pollutants (for example, fuel-operated systems and decontamination stations).
40 CFR 61.12, "Compliance with Standards and Maintenance Requirements"	Action and chemical	Requires the owner and operator of each stationary source to maintain and operate the source and associated air pollution control equipment in a manner that minimizes emissions.	Hazardous contaminants detected that include constituents that would be subject to NESHAP requirements if released to the air.	Relevant and appropriate	Remediation activities from stationary sources that have the potential to emit regulated air pollutants (for example, fuel-operated systems and decontamination stations).
40 CFR 61.14, "Monitoring Requirements"	Action	Requires the owner and operator to maintain and operate each monitoring system in a manner	Hazardous contaminants (that include NESHAP-regulated hazardous air pollutants) would need to	Relevant and appropriate	Remediation activities that involve monitoring systems, decontamination and

		consistent with air pollution control practices for minimizing emissions.	be monitored if released to the air.		stabilization of contaminated piles, treatment of wastes, and operation of exhausters and vacuums that may produce airborne emissions.

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
Solid Wastes					
Resource Conservation and Recovery Act of 1976 (42 USC 6901); Hazardous Waste Management Act of 1983 (I.C. 39-4401 et seq.); and Hazardous Waste Facility Siting Act of 1985 (I.C. 39-5801 et seq.)					
RCRA: Subtitle C—Exemption for Extraction, Beneficiation and Processing Mining Waste (40 CFR 261.4(b)(7))	Action	EPA exempts mining wastes from the extraction, beneficiation, and some processing of ores and minerals, in accordance with the Bevill amendment to RCRA.	Mining wastes were generated from Yerington Mine.	Applicable	Remediation of mining wastes that meet Bevill criteria.
RCRA: Subtitle C—Hazardous Waste Characteristics (40 CFR 261.20)	Action	Generators of solid waste must determine whether the waste is hazardous. A solid waste is hazardous if it exhibits the toxicity characteristic (based on extraction procedure Method 1311).	Solid waste may be generated during remediation in Arimetco OU-8.	Applicable	Remediation of solid wastes that are hazardous.
RCRA: Subtitle C—Hazardous Remediation Waste Management Requirements (HWIR-Media) (40 CFR 264.554)	Action	The use of staging piles can facilitate short-term storage of remediation wastes so that sufficient volumes can be accumulated for shipment to an off-site treatment facility or for efficient on-site treatment. The regulations contain performance standards for these piles.	Staging piles may be generated during remediation in Arimetco OU-8.	Applicable	Remediation using piles containing hazardous wastes.

RCRA: Subtitle C—Hazardous Waste Treatment and Storage (40 CFR 264)	Action	Requirements for storing or treating hazardous wastes in tanks, containers, or surface impoundments. Subpart F addresses groundwater monitoring	Containers or impoundments may be used in Arimetco OU-8 remediation.	Applicable	Remediation using containers or impoundments containing hazardous wastes.

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
		at hazardous waste treatment, storage, and disposal facilities. Closure requirements for hazardous waste repositories are covered under Subpart G. Hazardous waste landfills must meet minimum design standards under Subpart N.			
RCRA: Subtitle C—Treatment Standards for Hazardous Waste Debris (40 CFR 268.45)	Action	Hazardous debris must be treated through identified technologies or standards, unless EPA determines that debris is no longer contaminated, pursuant to 40 CFR 261.3(e)(2).	Debris generated during remediation of Arimetco OU-8.		Miscellaneous remediation activities that generate hazardous waste and debris.
RCRA: Subtitle D—RCRA Criteria for Classification of Solid Waste Disposal Facilities and Practices (42 USC 6901 et seq.; 40 CFR 257)	Action	Certain criteria are required to be met by solid waste disposal facilities and practices, such as not restricting the base flow of the floodplain, not taking threatened or endangered species, and not causing a discharge to navigable waters.	Waste disposal of potentially hazardous wastes may occur.	Relevant and appropriate	On-site disposal of contaminated piles and wastes in a floodplain.
RCRA: Subtitle D—Disposal of Nonhazardous Solid	Action	Provides criteria for cover material, runon/runoff control systems, access control, and	Evaporative remediation systems are proposed for Arimetco OU-8.	Applicable	Evaporative and other liquid containment remediation systems.

Waste (42 USC 6901 et seq.; 40 CFR 258)		liquid restrictions.			
OSWER, 1997, *Best Management Practices for Soil Treatment Technologies*	Action	Provides technologies for controlling cross-media transfer of contaminants during materials handling activities.	Soil treatment in Arimetco OU-8.	TBC	Excavation of contaminated soil and wastes.

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
40 CFR 264.18, Location Standards for Hazardous Waste Facilities, (a) Seismicity Considerations and (b) 100-year Floodplains	Location	Hazardous waste treatment, storage, and disposal facilities located in the vicinity of a fault must not be located within 61 meters (200 feet) of a fault, which has had displacement in Holocene time. Facilities located in a 100-year floodplain must be designed, constructed, operated, and maintained to prevent washout of any 100-year flood event.	Waste disposal of potentially hazardous wastes may occur.	Relevant and appropriate	Remediation involving the on-site disposal of contaminated piles and wastes in the vicinity of a fault or in/on 100-year floodplain.
40 CFR 268, "Land Disposal Restrictions"	Location and chemical	These requirements prohibit the placement of restricted RCRA hazardous waste in land-based units such as landfills, surface impoundments, and waste piles until treated to standards considered protective for disposal. Specific treatment standards are included in requirements.	Waste disposal of potentially hazardous wastes may occur.	Applicable	Treatment and on-site land disposal of RCRA hazardous wastes.
NAC, Waste Disposal					
NAC 444.850 through 444.8746, "Disposal of	Action	Adopts by reference, with certain modifications, federal hazardous waste	Hazardous wastes may be present in Arimetco OU-8.	Applicable	Identification, generation, management, and disposal of hazardous

Hazardous Waste”		regulations. To remain authorized, the hazardous waste program must periodically update the existing state regulations to reflect changes approved by EPA.			wastes generated as a result of remediation activities.

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
NAC 444.570 through 444.7499, "Disposal of Solid Wastes"	Action	Establishes standards for collection, storage, management, and disposal of wastes, and standards to operate disposal sites.	Solid wastes including, leachates, construction and demolition wastes, garbage, and refuse may be generated by Arimetco OU-8 remediation that are subject to these regulations.	Relevant and appropriate	Management and disposal of solid wastes generated as a result of remediation activities.
NAC 445A, Water Controls					
NAC 445A.430, "Stabilization of Spent Ore"	Action	Establishes stabilization requirements for spent ore.	Requirements would apply for stabilization of ore that has been spent and heaped.	Relevant and appropriate	Long-term management of heaped ore that has been spent in Arimetco OU-8.
NAC 445A.431, "Stabilization of Tailings"	Action	Establishes stabilization requirements for tailings.	Requirements would apply for stabilization of tailings that have been heaped.	Relevant and appropriate	Long-term management of heaped tailings that have been spent in Arimetco OU-8.
NAC 445A.434, "Minimum Design Criteria: Leach Pads and Other Nonimpounding Surfaces Designed to Contain and Promote Horizontal Flow of Process Fluids" NAC 445A.435, "Minimum Design	Action	Establishes standards for leach pads, other nonimpounding surfaces, ponds, and other containers to meet the specified engineered design and liner containment requirements.	Provide performance and design requirements for HLPs, ponds, ditches, containers, and nonimpounding containment devices.	Relevant and appropriate	Performance and design requirements for HLPs, ponds, ditches, containers, and nonimpounding containment devices.

Criteria: Ponds" NAC445A.436, "Minimum Design Criteria: Vats, Tanks, and Other Containers which Confine Fluids"					

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
NAC 445A.438, "Minimum Design Criteria: Liners"	Action	Establishes standards for soil and synthetic liners.	Provides performance and design requirements for liner systems.	Relevant and appropriate	Performance and design requirements for liner systems.
NAC 445A.446, "Permanent closure of facility" NAC 445A.447, "Plans for Permanent Closure; Sources Not Classified as Process Components" (Nevada Revised Statutes 445A.425 and 445A.465)	Action	Establishes standards for facility closure in accordance with NAC 445A.429, 445A.430, and 445A.431. Closure-related activities are coordinated by the Mining Closure Branch to evaluate chemical data to confirm stabilization of all applicable mine components (or sources) that must be considered for closure. The primary function of both the Mining Regulation Branch and the Mining Closure Branch is to ensure that "waters of the State," as described in Nevada Revised Statute 445A.415 are not degraded during and after a mining operation.	Site remediation activities may constitute closure of contaminated areas.	Relevant and appropriate	Permanent closure of the HLPs and evaporation ponds.
NAC 519A.245 through 345, "Reclamation of Land Subject to Mining Operations or	Action	Regulates land reclamation from mining and exploration projects.	Reclamation of affected land that was disturbed is required as part of the mining permit and requires a reclamation plan that	Relevant and appropriate	Substantive requirements for reclamation of land that was mined.

Exploration Projects"			addresses post-mining use, reclamation, and mine abandonment.		
WTS–37 Guidance Document for Design of Wastewater Detention Basins	Action	Miscellaneous NDEP Guidance Transmittals.	Site remediation activities that will address wastewater.	TBC	Remedial actions that are involved in the design and operation of wastewater containment systems as identified in these guidance

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
WTS–5 Guidance Document for Design of Wastewater Treatment Ponds WTS–6 and WTS–37 Guidance Document for Wastewater Pond System O&M NDEP Form 0590 Leak Detection Systems—Monitoring Results Bureau of Mining Limitations for Leak Detection Systems					transmittals.
Historical and Archeological Resources					
National Historic Preservation Act of 1966					
36 CFR 800, "Protection of Historic Properties" 40 CFR 6.301(b), "Applicant Requirements" Executive Order 11593, *Protection and Enhancement of*	Location	Requires federal agencies to consider the impacts of their undertaking on cultural properties through identification, evaluation, mitigation processes, and consultation with interested parties.	Cultural and historic sites may exist within the Arimetco OU-8 project area.	Applicable	Arimetco OU-8 project area investigation and remediation activities that are implemented in areas where cultural or historic sites exist.

the Cultural Environment 36 CFR 65, "National Historic Landmarks Program"					

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
36 CFR 60, "National Register of Historic Places"					
Native American Graves Protection and Repatriation Act of 1990 (25 USC 3001 et seq.)					
43 CFR 10, "Native American Graves Protection and Repatriation Regulations"	Location	Requires agencies to inventory, consult, and notify culturally affiliated tribes when Native American human remains and funerary objects are inadvertently discovered during project activities.	Native American cultural items, funerary objects, and human remains may exist within the Arimetco OU-8 project area.	Applicable	Arimetco OU-8 project area investigation and remediation activities that encounter applicable Native American human remains and funerary objects.
Archeological and Historic Preservation Act of 1974 (16 USC 469a-1 through 469a-2(d))					
40 CFR 6.301(c), "Applicant Requirements"	Location and Action	Requires that remedial actions do not cause the loss of any archeological or historic data. This act mandates preservation of the data; it does not require protection of the actual waste site or facility.	Archeological or historic sites may exist within the OU-8 project area.	Applicable	Arimetco OU-8 project area investigation and remediation activities that are implemented in areas where archeological or historic sites exist.
Natural and Ecological Resources					
Floodplain Management, Executive Orders 11988, 13690					
10 CFR 1022, "Compliance with Floodplain and	Location and Action	Take action to avoid adverse effects, minimize potential harm, and restore and	Some of the waste sites within Arimetco OU-8 that are subject to remediation	Applicable	Remedial actions that will occur in the floodplain.

Wetland Environmental Review Requirements"		preserve natural and beneficial values of the floodplain.	may be located within the Walker River floodplain.		
NAC 445A.6785, "Location restrictions: Floodplains" NAC 445A.679, "Location	Location and Action	Requirements that apply to solid waste disposal facilities that are intended to protect wetlands and floodplains.	Some of the waste sites within Arimetco OU-8 that are subject to remediation may be located within the Walker River floodplain.	Relevant and appropriate	Remedial actions that occur in the wetlands or the floodplain.

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
restrictions: Wetlands"					
Endangered Species Act of 1973 as amended (7 USC 136; 16 USC 1531 et seq.)					
50 CFR 402, "Interagency Cooperation—Endangered Species Act of 1971, as Amended" 40 CFR 6.302(c), "Responsible Official Requirements"	Action and Location	Prohibits actions by federal agencies that are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of habitat critical to them. Mitigation measures must be applied to actions that occur within critical habitats or surrounding buffer zones of listed species, in order to protect the resource.	Federally listed endangered and threatened species including fish, plants, and animals have not been identified on the project site, as determined by the most recent U.S. Fish and Wildlife Service assessment. The assessment of federally listed endangered and threatened species will be periodically re-evaluated for the Arimetco OU-8 project area.	Applicable	Remediation actions and investigation activities that occur within critical habitats or designated buffer zones of federally listed species.
Migratory Bird Treaty Act of 1918 as amended (16 USC 703 et seq.)					
Migratory Bird Treaty Act (16 USC 703–712); 50 CFR10.13	Action and Location	Protects all migratory bird species and prevents "take" of protected migratory birds, their young, or their eggs. 50 CFR 10.13 provides the list of protected migratory birds.	Migratory birds occur in the Arimetco OU-8 project area.	Applicable	Remedial actions that require mitigation measures to deter nesting by migratory birds on, around, or within remedial action site, and methods to identify and protect

					occupied birds' nests.
Fish and Wildlife Conservation Act of 1980 (16 USC 2901 et seq.)					
50 CFR 83, Fish and Wildlife Conservation Act of 1980s	Action and Location	Preserve and promote conservation of nongame fish and wildlife, and their habitats.	Nongame fish and wildlife. and their habitats may occur in the Arimetco OU-8 project area, but do not occur on the HLPs.	Applicable	Remedial actions that impact nongame fish and wildlife, and their habitats.

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
Federal Land Policy and Management Act (1976)					
Federal Land Policy and Management Act of 1976 (FLPMA) (43 USC 1701 et seq) Land Use Planning (43 USC 1712) Rights-of-Way under the Federal Land Policy and Management Act (43 CFR 2800)	Location	Establishes public land policy; establishes guidelines for its administration; and provides for the management, protection, development, and enhancement of the public lands. Provides for multiple use and inventory, protection, and planning for resources on public lands. In managing public lands, BLM is directed to take action necessary to prevent unnecessary or undue degradation of the lands. Actions taken on BLM—managed land should provide the "optimal balance between authorized resource use and the protection and long-term sustainability of sensitive resources".	Future reuse of OU-8 would be subject to established land use management and plans.	Applicable	Remedial actions that involve leaving HLPs on site.
U.S. Department of the Interior Bureau of Land Management (BLM), Carson City District, NV.	Location	Under the FLPMA, the BLM shall "develop, maintain, and when appropriate, revise land use plans" (43 USC 1712[a]). This RMP provides	Future reuse of OU-8 would be subject to established land use management and plans. OU-8 is located in Lyon	Applicable	Remedial actions that involve leaving HLPs on site.

Draft Resource Management Plan. Draft, November 2014.		planning-level guidance for the management of resources and designation of uses on BLM-administered lands.	County, which is within the Planning Area for this RMP.		

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

Regulatory Citation	ARAR Category	Description of Regulatory Requirements	Rationale for Use	Potential Relevancy	Possible Application for the Regulatory Requirement
		Ensures that impacted lands will be rehabilitated to accommodate productive, post-mining land uses by establishing multiple use goals and objectives, BLM management requirements, and monitoring and evaluation requirements. Establishes direction so that future decisions affecting BLM-managed lands will include an interdisciplinary approach to achieve integrated consideration of physical, biological, economic, and other sciences. Provides the direction for how the public lands are to be managed/administered by the Nevada BLM.			

Notes:

ARAR	*applicable or relevant and appropriate requirement*
BLM	*U.S. Department of the Interior Bureau of Land Management*
BMP	*best management practice*
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
EPA	*U.S. Environmental Protection Agency*

FLPMA	*Federal Land Policy and Management Act of 1976*
HLP	*heap leach pad*
HWIR	*Hazardous Waste Identification Rule*
MCL	*maximum contaminant level*
NAC	*Nevada Administrative Code*
NDEP	*Nevada Division of Environmental Protection*

Table 15 (continued)
Federal and State of Nevada Applicable or Relevant and Appropriate Requirements and To Be Considered

NESHAP	*National Emission Standards for Hazardous Air Pollutants*
NV	*Nevada*
OSWER	*Office of Solid Waste and Emergency Response*
OU-8	*Operable Unit 8*
PRG	*preliminary remedial goal*
Q&A	*question and answer*
RCRA	*Resource Conservation and Recovery Act of 1976*
RMP	*Resource Management Plan*
RSL	*regional screening level*
TBC	*to be considered*
USC	*United State Code*
WTS	*Water Technical Sheets*

Appendix A
Memorandum of Understanding
Between Environmental Protection Agency, Region 9 and Bureau of Land Management
Concerning the Anaconda Mine Site, Yerington, Nevada

Appendix B
NDEP Concurrence Letter
(will be added in future version)